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## NEW CHAPTERS IN THE WARFARE OF SCIENCE.

### VI.—DIABOLISM AND HYSTERIA.

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#### PART I.

IN the foregoing chapter I have sketched the triumph of science in destroying the idea that individual lunatics are "possessed by devils,"—in establishing the truth that insanity is physical disease,—and in substituting for superstitious cruelties toward the insane a treatment mild, kindly, and based upon ascertained facts.

The Satan who had so long troubled individual men and women thus became extinct; henceforth his fossil remains only were preserved; they may still be found in the sculptures and storied windows of mediæval churches, in sundry liturgies, and in popular forms of speech.

But another Satan still lived—a Satan who wrought on a larger scale—who took possession of multitudes. For, after this triumph of the scientific method, there still remained a class of mental disorders which could not be treated in asylums, which were not yet fully explained by science, and which therefore gave arguments of much apparent strength to the supporters of the old theological view: these were the epidemics of "diabolic possession" which for so many centuries afflicted various parts of the world.

When obliged, then, to retreat from their old position in regard to individual cases of insanity, the more conservative theologians promptly referred to these epidemics as beyond the domain of science—as clear evidences of the power of Satan; and, as the basis of this view, they cited from the Old Testament frequent references to witchcraft, and, from the New Testament, St.

Paul's question as to the possible bewitching of the Galatians, and Simon the magician's bewitching of the people of Samaria.

Naturally, such leaders had a large body of adherents in that class—so large in all times—who find that

> "To follow foolish precedents and wink
> With both our eyes, is easier than to think."*

It must be owned that their case seemed strong. Though in all human history, so far as it is closely known, these phenomena had appeared, and though every classical scholar could recall the wild orgies of the priests, priestesses, and devotees of Dionysus and Cybele, and the epidemic of wild rage which took its name from some of these, the great fathers and doctors of the Church had left a complete answer to any skepticism based on these facts; in their view the gods of the heathen were devils—these examples, then, could be transformed into a powerful argument for diabolic possession.†

But it was more especially the epidemics of diabolism in mediæval and modern times which gave strength to the theological view, and from these I shall present a chain of typical examples.

As early as the eleventh century we find clear accounts of diabolical possession taking the form of epidemics of raving, jumping, dancing, and convulsions—the greater number of the sufferers being women and children. In a time so rude, accounts of these manifestations would rarely receive permanent record; but it is very significant that even at the beginning of the eleventh century we hear of them at the extremes of Europe—in northern Germany and in southern Italy. At various times during that century we get additional glimpses of these exhibitions, but it is not until the beginning of the thirteenth century that we have a renewal of them on a large scale. In 1237, at Erfurt, a jumping disease and dancing mania began and afflicted a hundred children, many of whom died in consequence; it spread through the whole region, and fifty years later we hear of it in Holland.

But it was the last quarter of the fourteenth century that saw its greatest manifestations. There was much reason for them. It was a time of oppression, famine, and pestilence: the crusading spirit, having run its course, had been succeeded by a wild, mystical fanaticism; the most frightful plague in human history—the

* As to eminent physicians, finding a stumbling-block in hysterical mania, see Kirchhof's article, page 351, cited in previous chapter.

† As to the Mænads, Corybantes, and the disease "Corybantism," see, for accessible and adequate statements, Smith's "Dictionary of Antiquities" and Lewis and Short's "Lexicon"; also reference in Hecker's "Essays upon the Black Death and the Dancing Mania." For more complete discussion, see Semelaigne, "L'Aliénation mentale dans l'Antiquité," Paris, 1869.

black death—was depopulating whole regions, reducing cities to villages, and filling Europe with that strange mixture of devotion and dissipation which we always note during the prevalence of deadly epidemics on a large scale.

It was in this ferment of religious, moral, and social disease that there broke out in 1374, in the lower Rhine region, the greatest perhaps of all manifestations of "possession"—an epidemic of dancing, jumping, and wild raving.

The cures resorted to seemed on the whole to intensify the disease; the afflicted continued dancing for hours, until they fell in utter exhaustion. Some declared that they felt as if bathed in blood, some saw visions, some prophesied.

Into this mass of "possession" there was also clearly poured a current of scoundrelism which increased the disorder.

The immediate origin of these manifestations seems to have been the wild revels of St. John's Day. In those revels sundry old heathen ceremonies had been perpetuated, but under a nominally Christian form: wild Bacchanalian dances had thus become a semi-religious ceremonial. The religious and social atmosphere was propitious to the development of the germs of diabolic influence vitalized in these orgies, and they were scattered far and wide through large tracts of the Netherlands and Germany, and especially through the whole region of the Rhine. At Cologne we hear of five hundred afflicted at once, at Metz of eleven hundred dancers in the streets, at Strasburg of yet more painful manifestations; and from the greater cities they spread through the villages and rural districts.

The great majority of the sufferers were women, but there were many men, especially of those whose occupations were sedentary. Remedies were tried upon a great scale—exorcisms first, but especially pilgrimages to the shrine of St. Vitus: the exorcisms accomplished so little that popular faith in them grew small, and the main effect of the pilgrimages seemed to be to increase the disorder by subjecting great crowds to the diabolic contagion. Yet another curative means was seen in the great flagellant processions—vast crowds of men, women, and children who wandered through the country, screaming, praying, beating themselves with whips, imploring the divine mercy and the intervention of St. Vitus. Most fearful of all the great attempts at cure were the persecutions of the Jews. A feeling had evidently spread among the people at large that the Almighty was filled with wrath at the toleration of his enemies, and might be propitiated by their destruction: in the great cities and villages of Germany, then, the Jews were plundered, tortured, and murdered by tens of thousands. No doubt that, in all this, greed was united with fanaticism, but the argument of fanaticism was sim-

ple and cogent—the dart which pierced the breast of Israel at that time was winged and pointed from its own sacred books: the Biblical argument was the same used in various ages to promote persecution, and this was that the wrath of the Almighty was stirred against those who tolerated his enemies, and that because of this toleration the same curse had now come upon Europe which the prophet Samuel had denounced against Saul for showing mercy to the enemies of Jehovah.

It is but just to say that various popes and kings exerted themselves to check these cruelties. Although the argument of Samuel to Saul was used with frightful effect two hundred years later by a most conscientious pope to spur on the rulers of France in extirpating the Huguenots, the papacy in the fourteenth century stood for mercy to the Jews. But even this intervention was long without effect; the tide of popular superstition had become too strong to be curbed even by the spiritual and temporal powers.*

Against this overwhelming current science for many generations could do nothing. Throughout the whole of the fifteenth century physicians appeared to shun the whole matter. Occasionally some more thoughtful man ventured to ascribe some phase of the disease to natural causes, but this was an unpopular doctrine, and evidently dangerous to those who developed it.

Yet, in the beginning of the sixteenth century, cases of "possession" on a large scale began to be brought within the scope of medical research; and the man who led in this evolution of medical science was Paracelsus. He it was who first made modern Europe listen for a moment to the idea that these diseases are inflicted neither by saints nor demons, and that the "dancing possession" is simply a form of disease, of which the cure may be effected by proper remedies and regimen.

Paracelsus appears to have escaped any serious interference—it took some time, perhaps, for the theological leaders to understand that he had "let a new idea loose upon the planet"; but they soon understood it, and their course was simple. For about fifty years the new idea was well kept under, but in 1561 another physician, John Wier, of Cleves, having revived it, he was ruined and narrowly escaped with his life.

* See Wellhausen, article "Israel," in the "Encyclopædia Britannica," ninth edition; also the reprint of it in the "History of Israel," London, 1885, p. 546. On the general subject of the demoniacal epidemics, see Isensee, "Geschichte der Medicin," vol. i, pp. 260 *et seq.*; also Hecker's essay. As to the history of Saul, as a curious landmark in the general development of the subject, see "The Case of Saul, showing that his Disorder was a Real Spiritual Possession," by Granville Sharp, London, 1807, *passim*. As to the citation of Saul's case by the reigning pope to spur on the French kings against the Huguenots, I shall give a line of authorities in my chapter on "The Church and International Law." See also Maury, "La Magie et l'Astrologie dans l'Antiquite et au Moyen Age."

In the following century the Protestants of Holland were no less severe toward Balthasar Bekker, an eminent divine of the Reformed Church, who doubted some of the statements regarding possession.*

Although the new idea was thus resisted, it must have taken some hold upon thoughtful men, for we find that in the second half of the same century the St. Vitus's dance and forms of demoniacal possession akin to it gradually diminished in frequency and were sometimes treated as diseases. In the seventeenth century, so far as the north of Europe is concerned, these displays of "possession" on a great scale had almost entirely ceased; here and there cases appeared, but there was no longer the wild rage extending over great districts and afflicting thousands of people. Yet it was, as we shall see, in this same seventeenth century—in the last expiring throes of this superstition—that it led to the worst acts of cruelty.†

While this satanic influence had been exerted on so great a scale throughout northern Europe, a display strangely like it, yet strangely unlike it, had been going on in Italy. There, too, epidemics of dancing and jumping seized groups and communities; but they were supposed to arise from a physical cause, the theory being that the bite of a tarantula in some way provoked a supernatural intervention, of which dancing was the accompaniment and cure.

In the middle of the sixteenth century Fracastoro made an evident impression on the leaders of Italian opinion by using medical means in the cure of the possessed; though it is worthy of note that the medicine which he applied successfully was such as we now know could not by any direct effects of its own accomplish any cure—whatever effect it exerted was wrought upon the imagination of the sufferer. This form of "possession," then, passed out of the supernatural domain, and became known as "tarantism." Though it continued much longer than the corresponding manifestations in northern Europe, by the beginning of the eighteenth century it had nearly disappeared; and, though special manifestations of it on a small scale break out occasionally, even in these days, its main survival is the "tarantella," which the traveler sees danced at Naples as a catchpenny assault upon his purse.‡

* For Paracelsus, see "Isensee," vol. i, chap. xi; also Pettigrew, "Superstitions connected with the History and Practice of Medicine and Surgery" (London, 1844, introductory chapter. For Wier, see authorities given in my previous chapter. For Bekker, see citations in my chapter on "Witchcraft."

† As to this diminution of wide-spread epidemic in the seventeenth century, see citations from Schenk von Grafenberg and in Hecker, as above; also Horst.

‡ See Hecker's "Epidemics of the Middle Ages," pp. 87–104; also extracts and ob-

But, long before this form of "possession" had begun to disappear, there had arisen new manifestations, apparently more inexplicable. As the first great epidemics of dancing and jumping had their main origin in a religious ceremony, so various new forms had their principal source in what were supposed to be centers of religious life—in the convents, and more especially in those for women.

Out of many examples we may take a few as typical.

In the fifteenth century the chroniclers assure us that an inmate of a German nunnery having been seized with a passion for biting her companions, her mania spread until most, if not all, her fellow-nuns began to bite each other; and that this passion for biting passed from convent to convent into other parts of Germany, into Holland, and even across the Alps into Italy.

So, too, in a French convent, when a nun began to mew like a cat, others began mewing, and the desire spread and was only checked by severe measures.*

In the sixteenth century the Protestant Reformation gave new force to witchcraft persecutions in Germany. The new Church endeavored to show that in zeal and power she exceeded the old. But in France influential opinion seemed not so favorable to these forms of diabolical influence, especially after the publication of Montaigne's "Essays," in 1580, had spread a skeptical atmosphere over many leading minds.

In 1588 occurred in France a case which indicates the growth of this skeptical tendency even in the higher regions of the French Church. In that year Martha Brossier, a country girl, was, it was claimed, possessed of the devil. The young woman was to all appearance under direct satanic influence. She roamed about, begging that the demon might be cast out of her, and her imprecations and blasphemies brought consternation wherever she went. Myth-making began on a large scale; stories grew and spread. The capuchin monks thundered from the pulpits throughout France regarding these proofs of the power of Satan. The alarm spread, until at last even jovial, skeptical King Henry IV was disquieted, and the reigning pope was asked to take measures to ward off the evil.

Fortunately, there then sat in the episcopal chair of Angers a prelate who had apparently imbibed something of Montaigne's skepticism—Miron; and, when the case was brought before him, he submitted it to the most time-honored of sacred tests. He first brought into the girl's presence two bowls, one containing holy water, the other ordinary spring-water, but allowed her to draw a

servations in Carpenter's "Mental Physiology," London, 1888, pp. 312–315; also Maudsley, "Pathology of Mind," p. 73 and following.

* See citation from Zimmermann's "Solitude," in Carpenter, pp. 34, 314.

false inference regarding the contents of each: the result was that at the presentation of the holy water the devils were perfectly calm, but when tried with the ordinary water they threw Martha into convulsions.

The next experiment made by the shrewd bishop was to similar purpose. He commanded loudly that a book of exorcisms should be brought, and, under a previous arrangement, his attendants brought him a copy of Virgil. No sooner had the bishop begun to read the first line of the "Æneid" than the devils threw Martha into convulsions. On another occasion a Latin dictionary, which she had reason to believe was a book of exorcisms, produced a similar effect upon the devils.

Although the good bishop was thereby led to pronounce the whole matter a mixture of insanity and imposture, the capuchin monks denounced this view as godless. They insisted that these tests really proved the presence of Satan, showing his cunning in covering up the proofs of his existence. The people at large sided with their preachers, and Martha was taken to Paris, where various exorcisms were tried, and the Parisian mob became as devoted to her as they had been twenty years before to the murderers of the Huguenots,—as they became two centuries later to Robespierre,—and as they are at the present moment to General Boulanger.

But Bishop Miron was not the only skeptic. The Cardinal de Gondi, Archbishop of Paris, charged the most eminent physicians of the city, and among them Riolan, to report upon the case. Various examinations were made, and the verdict was that Martha was simply a hysterical impostor. Thanks, then, to medical science, and to these two enlightened ecclesiastics who summoned its aid, what fifty or a hundred years earlier would have been the center of a wide-spread epidemic of possession was isolated, and hindered from producing a national calamity.*

But during the seventeenth century a theological reaction set in, not only in France but in all parts of the Christian world, and the belief in diabolic possession, though certainly dying, flickered up hectic, hot, and spiteful through the whole century. In 1611 we have a typical case at Aix. An epidemic of possession having occurred there, Gauffridi, a man of note, was burned at the stake as the cause of the trouble. Michaelis, one of the priestly exorcists, declared that he had driven out sixty-five hundred devils from one of the possessed. Similar epidemics occurred in various parts of the world.†

Twenty years later a far more striking case occurred at Loudun, in western France, where a convent of Ursuline nuns was "afflicted by demons."

* See Calmeil, "La Folie," tome i, livre 3, c. 2. † See "Dagron," chap. ii.

The convent was filled mainly with ladies of noble birth, who, not having sufficient dower to secure husbands, had—according to the common method of the time—been made nuns, without any special regard to their feelings.

It is not difficult to understand that such an imprisonment of a multitude of women of different ages would produce some woful effects. Any reader of Manzoni's "Promessi Sposi," with its wonderful picture of a noble lady kept in a convent against her will, may have some idéa of the rage and despair which must have inspired such assemblages in which pride, pauperism, and the suppression of the instincts of humanity wrought a fearful work.

What this work was is to be seen throughout the middle ages; but it is especially in the sixteenth and seventeenth centuries that we find it frequently taking shape in outbursts of diabolic possession.*

In this case at Loudun, the usual evidences of satanic influence appeared. One after another of the inmates fell into convulsions; some showed physical strength apparently supernatural; some a keenness of perception quite as surprising; many howled forth blasphemies and obscenities.

Near the convent dwelt a priest—Urbain Grandier—noted for his brilliancy as a writer and preacher, but careless in his way of living. Several of the nuns had evidently conceived a passion for him, and in their wild rage and despair dwelt upon his name.

In the same city, too, were sundry ecclesiastics and laymen with whom Grandier had been engaged in various petty neighborhood quarrels, and some of these men held the main control of the convent.

Out of this mixture of "possession" within the convent and malignity without it, came a charge that Grandier had bewitched the young women.

The Bishop of Poictiers took up the matter. A trial was held, and it was noted that, whenever Grandier appeared, the "possessed" screamed, shrieked, and showed every sign of diabolic influence. Grandier fought desperately, and appealed to the Archbishop of Bordeaux, De Sourdis. The archbishop ordered a more careful examination, and, on separating the nuns from each other and from certain monks who had been bitterly hostile to Grandier, such glaring discrepancies were found in their testimony that the whole accusation was brought to naught.

But the enemies of Satan and of Grandier did not rest.

* On monasteries, as centers of "possession," and hysterical epidemics, see Figuier, "Le Merveilleux," page 40 and following; also Calmeil, Längin, Kirchhof, Maudsley, and others. On similar results from excitement at Protestant meetings in Scotland and camp-meetings in England and America, see Hecker's "Essay," concluding chapters.

Through their efforts Cardinal Richelieu, who appears to have had an old grudge against Grandier, sent a representative, Laubardemont, to make another investigation. Most frightful scenes were now enacted; the whole convent resounded more loudly than ever with shrieks, groans, howling, and cursing, until finally Grandier, though even in the agony of torture he refused to confess the crimes that his enemies suggested, was hanged and burned.

From this center the epidemic spread; multitudes of women and men were affected by it in various convents. Several of the great cities of the south and west of France came under the same influence; the "possession" went on for several years longer, and then gradually died out, though scattered cases have occurred from that day to this.*

A few years later we have an even more striking example among the French Protestants. The Huguenots, who had taken refuge in the mountains of the Cevennes to escape persecution, being pressed more and more by the cruelties of Louis XIV, began to show signs of a high degree of religious exaltation. Assembled for worship in wild and desert places, an epidemic broke out, ascribed by them to the Almighty, but by their opponents to Satan. Men, women, and children preached and prophesied. Large assemblies were seized with trembling. Some underwent the most terrible tortures without showing any signs of suffering. Marshal de Villiers, who was sent against them, declared that he saw a town in which all the women and girls, without exception, were possessed of the devil, and ran leaping and screaming through the streets.

Cases like this, inexplicable to the science of the time, gave renewed strength to the theological view.†

Toward the end of the same century similar manifestations began to appear on a large scale in America.

The life of the early colonists in New England was such as to give rapid growth to the germs of the doctrine of possession brought from the mother-country. Surrounded by the dark pine forests; having as their neighbors Indians, who were more than suspected of being children of Satan; harassed by wild beasts apparently sent by the powers of evil to torment the elect; with no varied literature to while away the long winter evenings; with few amusements save neighborhood quarrels; dwelling intently on every text of Scripture which supported their gloomy

* Among the many statements of Grandier's case, one of the best in English may be found in Trollope's "Sketches from French History" (London, 1878). See also Bazin, "Louis XIII."

† See Bersot, "Mesmer et le Magnétisme animal" (third edition, Paris, 1864, pp. 95 *et seq.*).

theology, and adopting its most literal interpretation—it is not strange that ideas regarding the darker side of nature were rapidly developed.*

The fear of witchcraft, thus developed, received a powerful stimulus from the treatises of learned men. Such works, coming from Europe, which was at that time filled with the superstition, acted powerfully upon conscientious preachers and were brought by them to bear upon the people at large. Naturally, then, throughout the latter half of the seventeenth century we find scattered cases of diabolical possession. At Boston, Springfield, Hartford, Groton, and other towns, cases occurred, and here and there we hear of death-sentences.

In the last quarter of the seventeenth century the fruit of these ideas began to ripen. In the year 1684 Increase Mather published his book, "Remarkable Providences," laying stress upon diabolical possession and witchcraft. This book, having been sent over to England, exercised an influence there and came back with the approval of no less a man than Richard Baxter. By this its power at home was increased.

In 1688 a poor family in Boston was afflicted by demons. Four children, the eldest thirteen years of age, began leaping and barking like dogs, or purring like cats, and complaining of being pricked, pinched, and cut. An old Irishwoman was finally tried and executed.

All this produced a deep impression on the mind of a man of great natural abilities, of most earnest and conscientious desire to do good in his generation, mixed with pride, vanity, ambition, and love of power; in short, a typical specimen of the high ecclesiastic as he has so often afflicted the earth. This man was Cotton Mather, the son of Increase Mather, and both father and son gave all their great powers to deepening and extending this theological view as sanctioned by Scripture.

In 1692 began a new outbreak of possession, which is one of the most instructive in history. The Rev. Samuel Parris was the minister of the church in Salem. No pope ever had higher ideas of his own infallibility, no bishop a greater love of ceremony, no inquisitor a greater passion for prying and spying.†

Before long Mr. Parris had much upon his hands. Many of his hardy, independent parishioners disliked his ways. Quarrels arose. Some of the leading men of the congregation were pitted against him. The previous minister, George Burroughs, had left the germs of troubles and quarrels, and to these were now added

* For the idea that America before the Pilgrims had been especially given over to Satan, see the literature of the early Puritan period, and especially the poetry of Wigglesworth, treated in Tyler's "History of American Literature," vol. ii, p. 25 *et seq.*

† For curious examples of this, see Upham's "History of Salem Witchcraft," vol. i.

new complications arising from the assumptions of Parris. There were innumerable wranglings and lawsuits; in fact, all the essential causes for satanic interference which we saw at work in and about the monastery at Loudun, and especially the turmoil of a petty village where there is no intellectual activity, and where men and women find their chief substitute for it in squabbles—religious, legal, political, social, and personal.

In this darkened atmosphere thus charged with the germs of disease it was suddenly discovered that two young girls in the family of Mr. Parris were possessed of devils; they complained of being pinched, pricked, and cut, fell into strange spasms and made strange speeches; showing all the signs of diabolic possession recognized in the works of experts or handed down by tradition. The two girls, having been brought by Mr. Parris and others to tell who had bewitched them, first charged an old Indian woman, and the poor old Indian husband was led to join in the charge. This at once afforded new scope for the activity of Mr. Parris. With his passion for magnifying his office, he immediately began making a great stir in Salem and in the country round about. Two magistrates were finally summoned. With them came a great crowd, and a court was held at the meeting-house. The scenes which then took place would have been the richest of farces had they not led to events so tragical. The possessed went into spasms at the approach of those charged with witchcraft, and when the poor old men and women attempted to attest their innocence they were overwhelmed with outcries by the possessed, quotations of Scripture by the ministers, and denunciations by the mob. The mania spread to other children, and one especially—Ann Putnam, a child of twelve years—showed great precocity and played a striking part in the performances. Two or three married women also, seeing the great attention paid to the afflicted, and influenced by that epidemic of morbid imitation which science now recognizes in all such cases, soon became similarly afflicted, and in their turn made charges against various persons. The Indian woman was flogged by her master, Mr. Parris, until she confessed relations with Satan; and others were forced or deluded into confession. These hysterical confessions—the results of unbearable torture, or the reminiscences of dreams, which had been prompted by the witch legends and sermons of the period—embraced such facts as flying through the air to witch gatherings, partaking of witch sacraments, signing a book presented by the devil, and submitting to satanic baptism.

The possessed had begun with charging their possession upon poor and vagrant old women, but ere long, emboldened by their success, they attacked higher game, struck at some of the foremost people of the region, and did not cease until several of these

were condemned to death, and every man, woman, and child brought under a reign of terror. Many fled outright, and one of the foremost citizens of Salem went constantly armed, and kept one of his horses saddled in the stable to flee if brought under accusation.

The hysterical ingenuity of the possessed women grew with their success. They insisted that they saw devils prompting the accused to defend themselves in court. Did one of the accused clasp her hands in despair, the possessed clasped theirs; did the accused, in appealing to Heaven, make any gesture, the possessed simultaneously imitated it; did the accused in weariness drop her head, the possessed dropped theirs, and declared that the witch was trying to break their necks. The court-room resounded with groans, shrieks, prayers, and curses; judges, jury, and people were aghast, and even the accused were sometimes thus led to believe in their own guilt.

Very striking in all these cases was the mixture of trickery with frenzy. In most of the madness there was method. Sundry witches charged by the possessed had been engaged in controversy with the Salem church people. Others of the accused had quarreled with Mr. Parris. Still others had been engaged in old lawsuits against persons more or less connected with the girls. One of the most fearful charges—which cost the life of a noble and lovely lady—arose undoubtedly from her better style of dress and living. Old slumbering neighborhood or personal quarrels bore in this way a strange fruitage of revenge; for the cardinal doctrine of a fanatic's creed is that his enemies are the enemies of God.

Any person daring to hint the slightest distrust of the proceedings was in danger of being immediately brought under accusation of a league with Satan. Husbands and children were thus brought to the gallows for daring to disbelieve these charges against their wives and their mothers. Some of the clergy were accused for endeavoring to save members of their churches.*

One poor woman was charged with "giving a look toward the great meeting-house of Salem, and immediately a demon entered the house and tore down a part of it." This cause for the falling of a bit of poorly nailed wainscoting seemed perfectly satisfactory to Dr. Cotton Mather, as well as to the judge and jury, and she was hanged, protesting her innocence. Still another lady, belonging to one of the most respected families of the region, was charged with the crime of witchcraft. The children were fearfully afflicted whenever she appeared near them. It seemed never

* This is admirably brought out by Upham, and the lawyer-like thoroughness with which he has examined all these hidden springs of the charges is one of the main things which render his book one of the most valuable contributions to the history and philosophy of demoniacal possession ever written.

to occur to any one that a bitter old feud between the Rev. Mr. Parris and the family of the accused might have prejudiced the children, and directed their attention toward the woman. No account was made of the fact that her life had been entirely blameless; and yet, in view of the wretched insufficiency of proof, the jury brought in a verdict of not guilty. As they brought in this verdict, all the children began to shriek and scream, until the court committed the monstrous wrong of causing her to be indicted anew. In order to warrant this, the judge referred to one perfectly natural and harmless expression made by the woman when under examination. The jury at last brought her in guilty. She was condemned; and, having been brought into the church heavily ironed, was solemnly excommunicated and delivered over to Satan by the minister. Some good sense still prevailed, and the Governor reprieved her; but ecclesiastical pressure and popular clamor were too powerful. The Governor was induced to recall his reprieve, and she was executed, protesting her innocence and praying for her enemies.*

Another typical case was presented. The Rev. Mr. Burroughs, against whom considerable ill will had been expressed, and whose petty parish quarrel with the powerful Putnam family had led to his dismissal from his ministry, was named by the possessed as one of those who plagued them, one of the most influential among the afflicted being Ann Putnam. Mr. Burroughs had led a blameless life, the only thing ever charged against him by the Putnams being that he insisted strenuously that his wife should not go about the parish talking of her own family matters. He was charged with afflicting the children, convicted, and executed. At the last moment he repeated the Lord's Prayer solemnly and fully, which it was supposed that no sorcerer could do, and this, together with his straightforward Christian utterances at the execution, shook the faith of many in the reality of diabolical possession.

Ere long it was known that one of the girls had acknowledged that she had belied some persons who had been executed, and especially Mr. Burroughs, and that she had begged forgiveness; but this for a time availed nothing. Persons who would not confess were tied up and put to a sort of torture which was effective in securing new revelations.

In the case of Giles Cory the horrors of the persecution culminated. Seeing that his doom was certain, and wishing to preserve his family from attainder and their property from confiscation, he refused to plead. He was therefore pressed to death, and, when in his last agonies his tongue was pressed out of his mouth, the sheriff with his walking-stick thrust it back again.

* See Drake, "The Witchcraft Delusion in New England," vol. iii, p. 84 *et seq.*

Everything was made to contribute to the orthodox view of possession. On one occasion, when a cart conveying eight condemned persons to the place of execution stuck fast in the mire, some of the possessed declared that they saw the devil trying to prevent the punishment of his associates. Confessions of witchcraft abounded; but the way in which these confessions were obtained is touchingly exhibited in a statement afterward made by several women. In explaining the reasons why, when charged with afflicting sick persons, they made a false confession, they said:

. . . "By reason of that suddain surprizal, we knowing ourselves altogether Innocent of that Crime, we were all exceedingly astonished and amazed, and consternated and affrighted even out of our Reason; and our nearest and dearest Relations, seeing us in that dreadful condition, and knowing our great danger, apprehending that there was no other way to save our lives, . . . out of tender . . . pitty perswaded us to confess what we did confess. And indeed that Confession, that it is said we made, was no other than what was suggested to us by some Gentlemen; they telling us, that we were Witches, and they knew it, and we knew it, and they knew that we knew it, which made us think that it was so; and our understanding, our reason, and our faculties almost gone, we were not capable of judging our condition; as also the hard measures they used with us, rendred us uncapable of making our Defence, but said anything and everything which they desired, and most of what we said, was in effect a consenting to what they said."* . . .

Case after case, in which hysteria, fanaticism, cruelty, injustice, and trickery played their part, was followed up to the scaffold. In a short time twenty persons had been put to a cruel death, and the number of the accused grew larger and larger. The highest position and the noblest character formed no barrier. Daily the possessed became more bold, more tricky, and more wild. No plea availed anything. In behalf of several women, whose lives had been of the purest and gentlest, petitions were presented, but to no effect. A Scriptural text was always ready to aid in the repression of mercy: it was remembered that "Satan himself is transformed into an angel of light," and above all resounded the Old Testament injunction, which had sent such multitudes in Europe to the torture-chamber and the stake, "Ye shall not suffer a witch to live."

Such clergymen as Noyes, Parris, and Mather, aided by such judges as Stoughton and Hathorn, left nothing undone to stimulate these proceedings. The great Cotton Mather based upon this outbreak of disease thus treated his famous book, "Wonders of

* See Calef, in Drake, vol. iii, pp. 56, 57; also vol. iii, pp. 38–46; also Upham.

the Invisible World," thanking God for the triumphs over Satan thus gained at Salem; and his book received the approbation of the Governor of the Province, the President of Harvard College, and various eminent theologians in Europe as well as in America.

But, despite such efforts as these, observation, and thought upon observation, which form the beginning of all true science, began a new order of things. The people began to fall away. Justice Bradstreet, having committed thirty or forty persons, became aroused to the absurdity of the whole matter; the minister of Andover had the good sense to resist the theological view; even so high a personage as Lady Phips, the wife of the Governor, began to show lenity.

Each of these was, in consequence of this disbelief, charged with collusion with Satan; but such charges seemed now to lose their force.

In the midst of all this delusion and terrorism stood Cotton Mather firm as ever. His efforts to uphold the declining superstition were heroic. But he at last went one step too far. Being himself possessed of a mania for myth-making and wonder-mongering, and having described a case of witchcraft with possibly greater exaggeration than usual, he was confronted by Robert Calef. Calef was a Boston merchant, and appears to have united the good sense of a man of business to considerable shrewdness in observation, power in thought, and love for truth. He began writing to Mather and others to show the weak points in the system. Mather, indignant that a person so much his inferior dared dissent from his opinion, at first affected to despise Calef; but, as Calef pressed him more and more closely, Mather denounced him, calling him among other things "A Coal from Hell." All to no purpose. Calef fastened still more firmly upon the flanks of the great theologian; thought and reason now began to resume their sway.

The possessed having accused certain men held in very high respect, doubts began to dawn upon the community at large. Here was the repetition of that which set men thinking under similar circumstances in the German bishoprics when those under trial for witchcraft there had at last, in their desperation or madness, charged the very bishops and the judges upon the bench with sorcery. The party of reason grew stronger. The Rev. Mr. Parris was soon put upon the defensive, for some of the possessed began to confess that they had accused people wrongfully. Herculean efforts were made by certain of the clergy and devout laity to support the declining belief, but the more thoughtful turned more and more against it; jurymen prominent in convictions solemnly retracted their verdicts and publicly craved pardon of God and man. Most striking of all was the case of Justice Sew-

all. A man of the highest character, in view of what he supposed the teachings of Scripture and the principles laid down by the great English judges, he had unhesitatingly condemned the accused; but reason now dawned upon him. He looked back and saw the baselessness of the whole proceedings, and made a public statement of his errors. His diary contains many passages showing deep contrition, and ever afterward, to the end of his life, he was wont, on one day in the year, to enter into solitude, and there remain all the day long in fasting, prayer, and penitence.

Chief-Justice Stoughton never yielded. To the last he lamented the "evil spirit of unbelief" which was thwarting the glorious work of freeing New England from demons.

The church of Salem solemnly revoked the excommunications of the condemned and drove Mr. Parris from their pastorate. Cotton Mather passed his last years in groaning over the decline of the faith and the ingratitude of a people for whom he had done so much. Very significant is one of his complaints, since it shows the evolution of a more scientific mode of thought abroad as well as at home: he laments in his diary that English publishers gladly printed Calef's book against witchcraft and possession, but would no longer publish his own, and he declares this "an attack upon the glory of the Lord."

## GLASS-MAKING.

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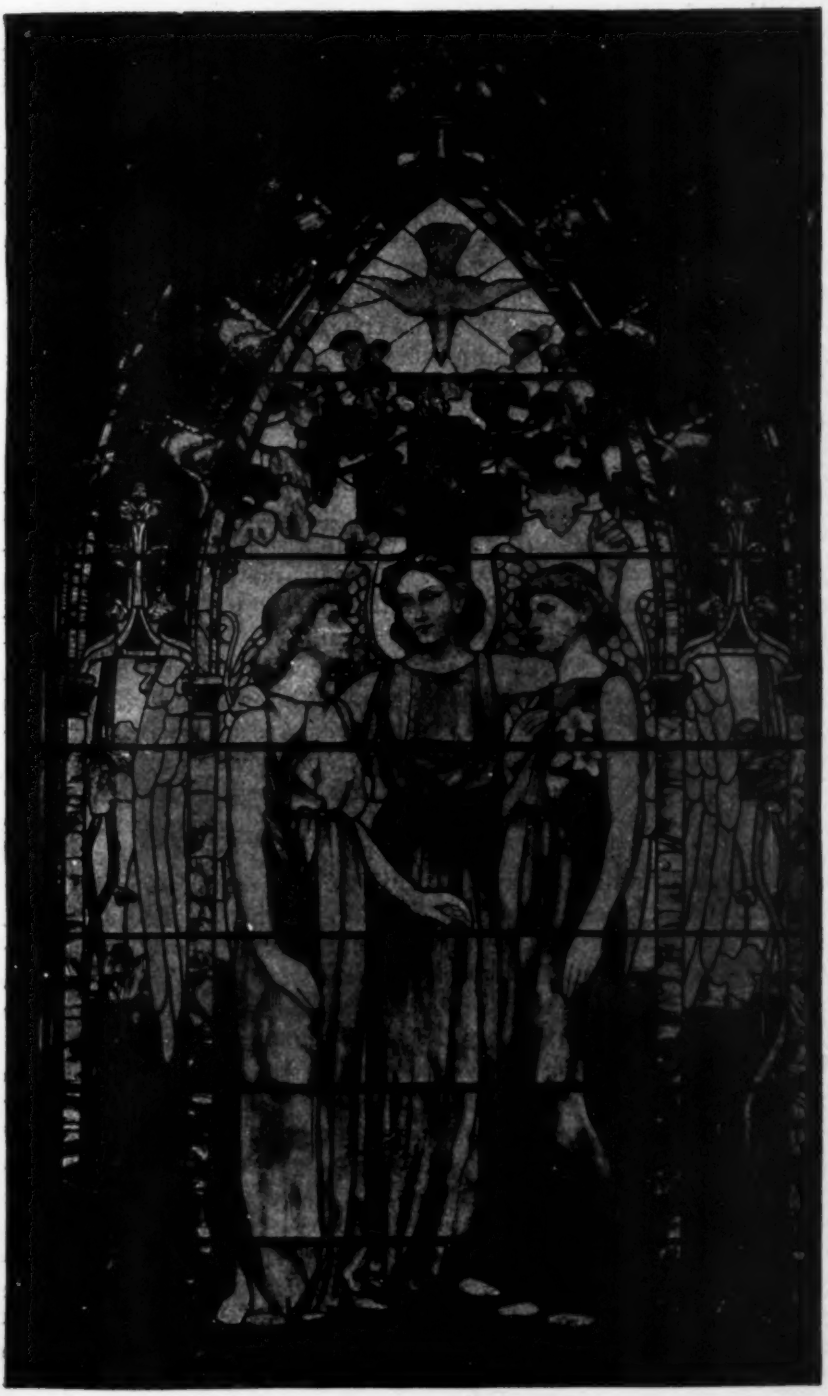
### II.—THE HISTORY OF A PICTURE-WINDOW.

IN the reproduction of the beautiful, Art has occupied itself chiefly with form and color, and has seldom made more serious demands upon light than to ask enough of it to reflect its achievements in these two directions to the eye of the beholder. So keen is the pleasure derived from well-adjusted proportions that our statuary and architecture please by their appeal to this one sentiment alone. When color joins with represented form, our delight in these harmonies is sufficiently complete to exclude for the time any sense of deficiency. We believe ourselves to be quite satisfied.

And yet, when we turn from these clever reproductions to the veritable nature of the outward world, or of our own unmaterialized fancies, our copies seem poor things after all. At best, they are so inadequate that one almost feels that the attempt is a mistake. The marble figure lacks the divine life that suffused and made adorable the human original. The painted atmosphere has



MEMORIAL WINDOW FINISHED. (Shown in process of manufacture in the following illustrations.)

not the spiritual light and transparency of the real heavens. The aureole encircling the sainted head does not palpitate with the living fire that glows in every sunbeam. Some element there is in nature's beauty that art has failed to catch. It may be, that in attempting to give permanence to impressions which are essentially transitory, a certain violence is done to the constitution of things, which we resent even while we admire. The beauty is too permanent. It is not one with the passing, ever-changeful moods of Nature.

We must not, however, be too exacting and demand the impossible. It is not to be expected that the pupil will equal the master. But the question is not unreasonable as to whether Art can not import into her work some of the life and the eternal ebb and flow which characterize that world of beauty which it is her province to attempt to reproduce. Form and color are large elements, but they do not make up nature. There must be light and motion, else the scene is deficient in its chief charms. True, it is impossible to realize motion in very fact: the strained muscle and unstable poise can only suggest it. Nor is it possible, working with marble and canvas, to realize the life and light of the real ether. This is something too subtile to be simulated. But it may be borrowed. By giving expression to his conceptions in translucent materials, the artist may so strain and filter the sunlight that it shapes itself at his bidding into such pictures as he will. And the beholder, seated on his bench before it, or perhaps kneeling in a reverential mood, loses himself in this fine vision, and under its influence sends out his thoughts over broader ranges and higher planes.

I remember distinctly, as a child, the keen pleasure I used to get from a picture-window that faced me during afternoon church. It was a poor thing, artistically—Zaccheus on the bough of a very inadequate-looking sycamore-tree, with a passing multitude of such dimensions as to make tree-climbing seem absolutely superfluous—but in the early winter twilight I found the picture very beautiful. When the increasing darkness had softened the group in the foreground into a pleasant harmony, there was a strip of sky along the horizon that sprang into glowing life. And in that bit of light I used to wander over the Judean hills in happy abstraction until the music and the benediction called me back again to the more prosaic life of an American city.

It is this added element in glass that makes it so fitting a material for the expression of artistic conceptions. It is a sensitive vehicle for the carriage of a beautiful thought. The material possesses a wealth of the purest color; it permits in its shading the accurate representation of form, and it furnishes something that marble and canvas do not—large possibilities in the way of light

and of effective changeableness. These considerations are attracting the attention of artistic people, and probably in no other field is there better work being done to-day. It is true that the material is fragile—very fragile—but then few works of art are fashioned with the idea of rough usage. If protected from mere mechanical injury, glass will outlast many forms of matter apparently much more robust. Particularly is it proof against that ever-present enemy, the atmosphere. Stone crumbles and decays, metals corrode, and pigments fade, but glass defies nearly everything but fracture. The few glass ornaments that have come down to us from the ancient world are in a state of superior preservation. Glass and terra-cotta, fragile as they are, seem better adapted than even tablets of stone for preserving the records of the past. Clay cylinders from Assyria, depicting the story of the garden of Eden, are a part of historical record still extant: the graven decalogue is no more.

The subject of picture-windows is a very large one, since their fabrication demands the exercise of such diverse faculties. Viewed from either the artist's or the technologist's standpoint, it presents many features of interest. In our nomenclature we have permitted ourselves to fall into rather careless habits. The terms "painted," "stained," and "mosaic" glass are used indiscriminately to designate any form of window-glass work which involves color, but a moment's consideration will show them to be far from synonymous. Some of our best effects are produced without the use of either paint or stain, and such windows have the advantage of a much greater durability. In painted glass the colors are produced by enamels fused to the surface of the glass by means of heat. In stained glass, a permanent transparent color effect is secured by the action of heat on certain metallic oxides applied to the surface as pigments; while in mosaic glass, pure and simple, the design is brought out by the use of shaped fragments of colored glass bound together by strips of doubly grooved lead.

The three products, it will be seen, are quite distinct. It frequently happens, and in the older examples of ecclesiastical design it is nearly always the case, that all are combined in one window. But at the present time there is a strong reaction against the employment of either paint or stain, since they are not only less durable but also less brilliant than homogeneous colored glass. There is a decided tendency to rely entirely upon the mosaic treatment, and to limit the use of paint to the representation of the human figure.

The manufacture of mosaic glass has attracted the attention of men of such ingenuity and taste that it deserves its rank among the fine arts. It has attained a degree of artistic perfection of

which the earlier examples gave only sparing promise. In spite of the abandonment of paint and stain, the mosaic glass has been given greater variety and greater depth of color than at any time since the Renaissance. In its present form, the mosaic picture-window is a distinctively American product. It has been evolved here, and, though now somewhat copied in Europe, it is here that the process has reached its greatest extension and perfection. The history of its mode of becoming is both unique and interesting. It is one that could not have been written much earlier to advantage, for the material of which it is composed has only been gathering during recent years. Were this history to be unfolded logically, it would start with the first conception which shaped itself in the brain of the artist, and from that intangible beginning it would be traced through the colored sketch, the full-sized cartoon, the gradual replacement of colored paper by colored glass, and so on to the completed window; but that would presuppose too much. It would take for granted that the artist in glass had only to catch his fine dreams of beauty, and that the material for their expression would be found at hand ready for his use. But such is very far from being the case. In this form of art-work the real struggle has been to make the material adapt itself to the conception it is intended to express. The struggle, however, has been carried on so cleverly and so successfully that the ultimate triumph is the more enjoyable for the prelude. It is more consistent, therefore, to consider first the technical part in the history of a picture-window, the production of that adroitly wrought and daintily colored material which has made the window possible; and then, having won the material, to regard its subsequent disposition in producing the fine effects which make it so admirable.

To describe every variety of glass utilized in a mosaic picture-window would be to describe nearly every form of glass known in the flat. In such a window, be it remembered, the entire picture, except the exposed portions of the figure, is brought out by the use of shaped fragments of colored glass; and one can readily imagine that, as all possible subjects are chosen for such representation, all possible shades and combinations and effects are needed in the glass employed. Draperies, vegetation, architecture, sky, earth, air, and water, are all successfully depicted without the use of either paint or stain. Such windows, except the flesh portions, are true mosaics, and of the most brilliant kind.

To acccomplish these wonders the glass has been made in all the colors of the spectrum, and has undergone a thousand different transformations. The shapes have been no less varied than the colors. The so-called "jewels," or pieces of richly colored glass, cut with facets after the manner of precious stones, have

added immensely to the brilliancy of modern designs, and have been particularly effective when introduced as a setting or framework to a picture-window. They are imported for the most part from Germany. The greater part of the flat glass used, however, is made in the immediate neighborhood of New York, under the direct supervision of the art-workers who are to utilize it. I had recently the pleasure of going through such a factory in Brooklyn, probably the largest of the kind in this country, and it was a veritable chromatic treat to visit the store-rooms, for some five hundred different color combinations were recognized in stock. The mosaic ateliers of the Vatican contain, it is true, not less than twenty-six thousand different tints; but these, it must be remembered, are simply opaque enamels, while the glass mentioned is all easily translucent, and much of it is clearly transparent.

In the manufacture of this glass the materials employed are much the same as in ordinary sheet and plate glass. It is a double silicate of lime and soda, the coloring being due to the addition of metallic oxides which are soluble in the fused glass. The mate-

IN THE GLASS-SHOP. SELECTING THE GLASS FROM THE SHEETS.

rials needed for the basis are, as before, sand, limestone, and alkali. They are mixed in the proper proportions—that is to say, about thirty parts of lime and forty of soda to every hundred parts of sand—and are fused in fire-clay crucibles in the customary glass-furnace. The coloring matter is added at different stages of the process, according to the nature of the material.

The mineral world has been pretty thoroughly ransacked to

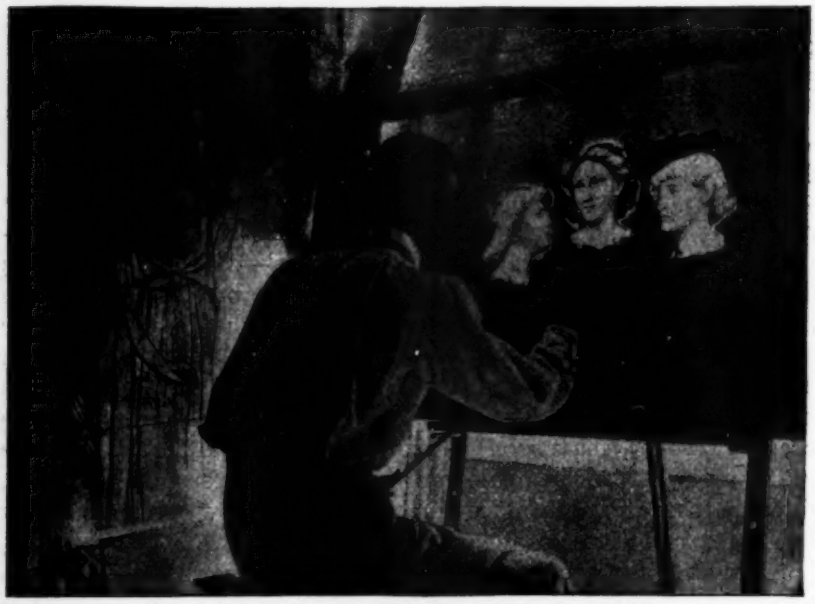
obtain the needed colors, and additions to the list are constantly being made as the result of further experimentation. Taking the colors up in the order of the spectrum, the violet shades are generally produced from manganese or from very small quantities of cobalt; the deep blues, indigos, purple blues, and normal blues, from varying proportions of cobalt; peacock-blue from copper; the finest greens from copper and chromium; and the dull sea-water tint from ferrous oxide. The oxide of copper gives an emerald green. The yellows come from a variety of sources: the sesquioxide of uranium gives a fine fluorescent yellow; the oxide of lead a pale yellow, and the oxide of silver, applied as a pigment to the surface of the glass, a permanent yellow stain. The higher oxide of iron gives an orange color, but, as it has a strong tendency to become reduced, it is necessary during the manipulation of the glass to keep some oxidizing agent present, such as manganic oxide. In the reds a number of excellent shades are readily obtainable. Manganese furnishes a variety of pinkish reds and pinks; copper, in its lower oxide, the fine blood-red of Bohemian glass; and gold, the deepest and most brilliant of all reds, the well-known ruby glass. This list, however, is but a fragment. It bears to the complete array of color at the command of the glass-worker much the same relation that an inventory of crude pigments would bear to the fine distinctions housed in an artist's color-box. It is only intended to give some little idea of the mineral bases utilized for their color effect. The fine gradations of color, and the rich and delicate tones, are the result of no such elementary chromatics. Many substances have joined their forces to produce these fine results. In many cases they have been obtained only after long experimentation, and have a corresponding value in the eyes of their discoverers. The magnificent window designed by Mr. John La Farge, which now faces the chancel in Trinity Church, Boston, owes the brilliancy of its peacock hues to the combined forces of some seventeen ingredients. This is an extreme instance of complexity, but it fairly represents the present tendency to secure a multitude of effects even at the expenditure of a multitude of agents.

In addition to these metallic compounds a number of other substances are used to produce either colors or unique effect. A little carbonaceous matter yields an amber tint of very agreeable hue, while the opalescence now so much in vogue and so justly admired results from the presence of oxide of tin, arsenic, or lime, or from native minerals, such as fluorite or the cryolite now imported in such large quantities from Greenland. The superiority of American art-work in glass is largely due to the introduction of this effective opalescent glass. It was first used in this country about ten years ago, by Mr. John La Farge and Mr. Louis C.

Tiffany. The idea is due to Mr. Tiffany, and suggested itself in the most accidental manner. His own collection of glass included several Venetian wine-glasses made of thin opalescent glass, as well as several of thin transparent ruby of the quality used in ordinary colored window glass. As a painter he was naturally keenly alive to all color effects, and could not fail to be impressed with the contrast presented by the two glasses. The opalescent afforded such varying and beautiful effects, and seemed to possess so many advantages over the ordinary transparent glass, that the idea flashed upon him that if the ruby glass could be made use of in windows, why could not the opalescent as well? He decided at any rate to attempt its introduction. After long and careful experimenting he succeeded in obtaining a sufficient quantity of glass for the construction of a window. There were so many difficulties to be overcome, however, that for a time it seemed doubtful whether the glass could ever be largely introduced. That question has now been so far set at rest that the glass may be said to enjoy too great a popularity for its own good. Its reputation has been somewhat injured at the hands of enthusiastic glass-workers—"glass sinners," Mr. Tiffany calls them—whose taste in this direction appears to have suffered chromatic aberration. It is the apparent ambition of these people to combine the greatest number of colors in the smallest possible space, and the results have been unhappy to such a degree as to frighten more sober-minded lovers of beauty from paths so seemingly dangerous. This unfortunate craze, however, may soon be expected to spend itself, and the really artistic work in opalescent glass will suffer no permanent damage from the nightmares in color which now disfigure many even of our better-class tenements and hotels.

But the glass-worker has only begun his work when he has the molten "metal" simmering in his crucibles. It must undergo many subsequent manipulations before it is available for the purpose of art. Some of these, from a technical point of view, seem retrogressional. It has been found that the rich color effects in glass of the middle ages are largely due to the imperfections in the material. Its lack of homogeneousness, its unequal thickness, and uneven surfaces contribute largely to its beauty. The modern product is too uniform to be brilliant; it transmits the light with too great regularity. Intentional imperfections are, therefore, introduced into the process; and the products, in consequence, are much more satisfactory to the artist. This work of individualizing the product has now been so far systematized that several special brands of art glass are recognized in the markets. The so-called antique glass, in both white and colors, is made precisely like the ordinary sheet window glass, except that the surface of the glass is made full of minute blow-holes, which produce almost

an aventurine effect, and add greatly to its brilliancy. In the cathedral glass the surface is rendered wavy and uneven, so that the transmission of light shall be correspondingly irregular. In the flash glass ordinary sheets are covered with a thin plating of colored glass, a process which permits a very delicate color tone, and materially decreases the expense, where a costly glass, such as ruby, is needed to give the color. But in mosaic work it is now generally preferred that the glass shall not be at all transparent, since the effect is much richer. The most of the glass is therefore cast, the process being a repetition in miniature of the



IN THE PAINTING-ROOM. THE ARTIST LAYING IN THE HEADS.

casting of rough plate. The pots containing the molten colored glass always remain, however, in the furnace, and the "metal" is dipped out in small iron ladles. It is poured at once on a little casting table, and is smoothed out by means of an iron roller. The small sheets thus obtained are readily handled, and permit the use of the convenient rod leer. In this, the annealing process requires from three to six hours, and at the end of that time the sheets are ready for use.

In case more than one color is to appear in the same sheet, the effect is obtained by mixing together several masses of differently colored and still plastic glass on the casting table, by means of a copper instrument not unlike a plasterer's trowel. In this way three or even four colors are combined in the same piece of glass, and, though the results are always more or less experimental,

artists have learned to adapt them to their picture-windows as well as to their geometrical designs. The workmen have attained no little skill in the art of mixing. They have learned to reduce the accidental element in this apparently hit-or-miss process to a minimum, and with a fair degree of accuracy to secure predetermined combinations. The mixture of blue and white translucent glass in particular is made to represent sky effects as naturally as if the colors had been laid on by an artist's brush. It is true that this combination is prone to represent an August sky; but this is not to be regretted, since at no other season of the year are the heavens more beautiful.

By this mode of manufacture the glass has an unequal thickness and consequent varying depth of color that well adapt it for art purposes. For certain uses, however, particularly for drapery, the differences in color tone are still not sufficiently great, and other devices must be resorted to. A special product, known as drapery glass, has of recent years been added to the already extended list, and produces a most excellent effect. While the sheet of glass on the casting table is still sufficiently hot to be plastic, it is seized by suitable tools, and rumpled up until it looks like a piece of crumpled cloth. It is permitted to cool in this condition, and, when introduced into a picture-window, presents a luminous substitute scarcely less natural than real drapery. One is almost tempted to run his hand over the folds to try their texture.

It is by processes so painstaking and so ingenious as these that the material for our picture-window is won. The industry is still a comparatively new one, yet so marked are the improvements witnessed by the passing years that the artist is now almost unrestricted in making the design of his window. Should it contain any effects not expressible in materials already at hand, the deficiency is only an incentive for further effort, and the needed material is pretty sure to be speedily forthcoming.

So much for the body of our window: the soul of it comes by a less visible process.

In some quiet moment, under the influence of a strong sentiment, or in the face of an inspiring vision, a suggestion of beauty is evolved in the artist mind. Why it comes in one brain rather than in another it would be difficult to say. Whether it is the result of some subtile chemical reaction in the gray and the white, or the incomprehensible force that has caused this reaction, it seems almost useless to inquire. But in some way or other the vision comes, and finds lodgment under a hospitable roof. It is entertained and communed with until it takes definite shape, and the conception is committed to paper. It is at first little more than a suggestion, a small colored sketch. If this prove satisfactory, it becomes the nucleus of a window, and undergoes its first

metamorphosis, enlargement. From the beginning of its career until finally, after months or years, the picture is in place and the bright sunlight illumines it, the different steps in the transformation involve never-ceasing care and thought. At any step a failure of attention might mean a total failure of the work. To follow this little sketch in its growth toward a window, will be to watch its fortunes under many different hands and under widely varying circumstances.

As the Tiffany Glass Company of New York has been particularly successful in adapting the mosaic treatment to picture-windows, their studios furnish typical illustrations of the several steps. Ordinarily the artist simply furnishes the small colored sketch, and from this germ the window is evolved. Occasionally he goes a step further, and supplies a cartoon in black and white of the natural size. It is only in rare instances that he does the full-sized sheet in colors. Not unfrequently the suggestion for a window is taken from some celebrated painting or engraving. The Tiffany Company recently reproduced Gustave Doré's famous picture, "Christ leaving the Prætorium," for a church memorial window, the entire piece being executed in pure mosaic, with the exception of the faces and hands. The dimensions of this truly magnificent work of art are twenty by thirty feet. It is the most ambitious window ever attempted in America, and, indeed, the largest opalescent piece in the world. In many cases, however, the suggestion comes from humbler sources. A very beautiful window designed by Mr. E. P. Sperry—"Faith, Hope, and Charity"—and recently completed as a memorial window for the Unity Church at Springfield, Mass., sprang from a thought suggested by a Christmas card. Where the design for a window is ordered and paid for by the purchaser of the window, it is of course impossible to secure a duplicate; but where a picture that is already common property is reproduced, the work may be several times repeated. Thus "The Good Shepherd," a very satisfactory figure of the Christ taken from the well-known painting by Frederick J. Shields, has been reproduced in glass three times, and now adorns as many churches in different parts of the country. It is too beautiful a conception to be rendered any less pleasing by this repetition. In all cases the patterns and other needed guides are preserved, so that, should the occasion arise, a picture-window once executed may be readily duplicated. A window has just been completed for the Buffalo Cathedral, to take the place of one recently destroyed by fire. It is a very close duplicate of the original work. But while the success in reproducing pictures already extant has been very marked, a keener pleasure is derived from modern pictures designed originally for execution in glass. Many of these are exceedingly beautiful, and represent

the thought of some of the best artists of the modern American school.

The enlargement of the colored sketch to natural size is accomplished by women artists, who work standing before large sheets of heavy brown paper tacked against the walls of the studio. While this mode of procedure would in any case be necessitated by the large size of the cartoons, it has the independent value of per-

In the Decorating-Room. Treating the Leads.

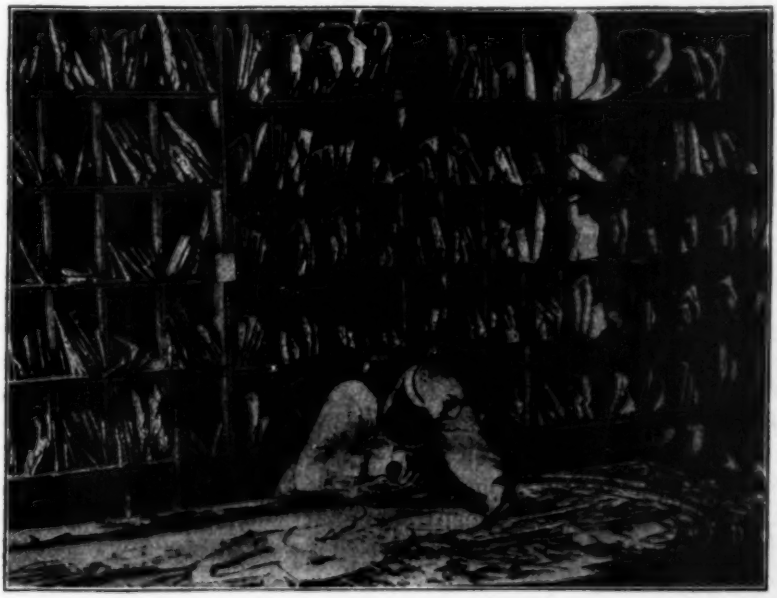
mitting the progress of the work to be checked at all stages by long-range scrutiny. As much of the enlargement as possible is done mechanically, but at best there remains much free-hand work requiring genuine artistic feeling. Indeed, throughout the entire process, true artists are needed in the most mechanical portions to make the success of the adventure complete. When the enlargement is finished, the cartoon is divided up by heavy black lines so disposed as to represent the doubly grooved lead needed to hold the fragments of colored glass together. Sketch and cartoon are now taken to the glass store-room, and appropriate glass for the window is selected and laid aside. If suitable material is not found in stock, it is ordered in such quantity that the discovery of right effects may reasonably be expected. As the accidental element, in spite of all the skill on the part of the glass-worker, is necessarily large, it sometimes happens that a ton of glass must be searched over to find a few pounds of just the right sort. In some cases several months pass before appropriate material can be selected.

The search for material ended, the work of construction may begin. Two duplicate copies of the cartoon are first made. One operation suffices to accomplish this. The cartoon is laid on a large table, and beneath it are two sheets of similar paper and two sheets of ordinary black transfer paper arranged alternately. By passing a small revolving wheel over the outlines of the cartoon, the tracings are quickly and accurately made. Each space is then numbered correspondingly on both tracings, and one of them is cut up to make patterns for the glass-cutter. An ingenious dissecting instrument is used for this purpose. It consists of a pair of double-edged shears, which, in cutting, removes a strip of paper just the width of the lead which will separate the fragments of glass when they are finally bound together. In this way each pattern is precisely the size required. When the glass is ready to be put together in the window, there is very little coaxing to be done to get it into place.

The picture-window has now reached the most critical stage in its development. The paper patterns are to find suitable counterparts in glass, and upon the nicety with which this substitution is accomplished depends the effect of the entire work. Nothing is left undone that will assist the glass-cutter in forming correct color-judgments. Throughout the entire process, and here particularly, the work progresses under precisely those conditions that are best calculated to make surprises and incongruities impossible when the whole shall be completed. A sheet of plain glass, the size of the cartoon, is laid over the undissected tracing. Outlines of the intended lead bands are then painted on the clear glass in black lines of corresponding width. On the model thus prepared the paper patterns are stuck by means of a little wax. It is now ready to be taken to the figure-room, where it is placed directly in front of a large window, and the slow work of substituting colored glass for paper begins. The position in which the completed window is to be placed must constantly be borne in mind, and the treatment adopted be made to conform to the requirements of light and neighborhood. A window that will be effective when seen against a clear northern sky will probably be somewhat dull if turned to some other point of the compass and seen against a dark background of brick walls and shadows, while a window that would be a delight under these more somber conditions would be insupportably glaring against the stronger light. Consideration must also be paid to whether the window is to be seen commonly at long or short range, and to the general color tone of neighboring windows and walls.

Piece by piece the paper patterns are removed, and the shaped fragments of glass take their place. Each fragment is obtained by repeated trials until just the right effect is secured. When the

fragment has been selected and shaped, it is also held to the sheet of clear glass by means of a little wax, and another paper pattern is removed, to be similarly replaced by glass. In this manner the removal and replacement go on step by step until the entire work is done. The colored sketch and the enlarged cartoon are always kept in sight, so that the spirit of the picture may be realized as completely as possible. The workmen who thus select and cut the glass have acquired a surprising skill in adapting its accidental variations to the needed expression of the thought. In many cases they entered the studio as boys, and have been slowly trained to perform this difficult work with much nicety of judgment. In mosaic glass of purely geometrical design, the requirements of



Soldering Joints of Lead Lines.

color harmony alone need attention; but in the picture-window, in addition to this, a very appreciative eye is needed to seize upon just the right combinations to bring out the draperies and the background and the sky. It is frequently impossible to secure the desired effect with one thickness of glass, and the custom of doubling the glass is becoming more prevalent each year. This practice gives both better drawing and deeper color. In the matter of draperies, particularly, the method leaves little to be desired. In the window representing "Faith, Hope, and Charity," the draperies of the three figures were executed in white opalescent glass, and the dainty shades desired—pale green, pink, and yellow—secured by placing back of this, fragments of plain glass of the

proper color. The effect could scarcely have been more delicate, yet the color tones were full and strong.

In another window, the design of Mr. Will H. Low, the draperies of a seated figure were executed in a vivid blue. The sketch called for a rich purple, and any one passing through the studio at this stage of progress would have been inclined to resent the seeming liberties taken by the workmen. The artist's intentions evidently were only half carried out. But, while one stands pondering over the excessive amount of assurance possessed by people of a certain class, one of their number has quietly slipped a piece of ruby glass back of the draperies, and at once the vivid blue vanishes to give place to a magnificent purple as much finer than the artist's paper-color as the sunshine is better than gas-light.

In this plan of doubling the glass the colorist has in his possession a device of immense effectiveness. The entire color tone of a window can readily be changed, even after it is completed and in place.

When the window is well under way, the preparation of the flesh portions of the picture begins. These are cut from white opalescent glass, and must be painted with no inconsiderable skill. In the early days of mosaic glass the painting was done almost in monochrome, a light reddish brown being a favorite tint. It had, however, the disadvantage of giving a statue-like sameness to all the figures. Had the taste continued, our windows would have become an assemblage of rather monotonous blonde types. But to-day there is great variety in this respect, and the painting of the face and other exposed portions of the figure is made to conform very strictly to the character of the whole picture. In ecclesiastical designs done in mediæval style, the painting is executed in a pinkish-brown monochrome on transparent antique glass. The effect is so very Elizabethan that it is hard to believe the work a modern product, unless one has seen it in process of evolution. For the saints and Madonnas of the early masters, the high cheek-bone and other characteristics of feature are reproduced with remarkable fidelity. But, while these products are highly interesting, they are in point of beauty far excelled by modern types. To the production of these nearly the whole range of mineral paint has contributed. One of the finest examples of the modern school of painting on glass is to be found in the face of "The Good Shepherd," in which nearly every possible color has been used. At a distance one is not conscious of any particular color, but is attracted by the intense life and love shown in the face. Rather bold expedients are often employed to secure these striking effects. In one face, whose eyes were more than usually expressive of life, the result was obtained by bands of bright green bordering both eyelids.

The manner of painting the flesh portions is not without interest. The pieces of opalescent glass are mounted in rough frames before a window, and nearly all other light is cut off. In this way the artist can see his work under precisely the same conditions that will prevail when the window is put in place, and he can paint to correspondingly good advantage. The colors are put on rather heavy to allow for firing, and for the distance at which the faces will commonly be seen. In many cases the paint is put on solidly, and is then picked off with a sharp instrument, giving much the effect of an etching. It looks a little eerie, on going into such a studio, to see a group of heads and hands, and other severed members of the anatomy staring at one in luminous characters. The painting must be done in installments, as it is necessary to fire the glass from two to four times. Each firing requires about an hour and a half, and six hours more for the kiln to cool down. Before the last firing the flesh portions are taken to the figure-room and given place in the otherwise completed picture. In this way the artist can judge of the final colors needed to bring them into perfect harmony with the general color tone of the picture.

It is by the expenditure of such care and labor that the soul and body of our picture-window are brought together; but, before the union is made permanent, the window undergoes a searching art scrutiny, and any changes are suggested that would add to its beauty and harmony. In some cases all the combinations have proved so fortunate that very few changes are needed; but the case is not always so easily disposed of. It happens at times that portions of the glass must be recut several times before the desired effect is secured; or, even after the window is completed, the discovery is sometimes made that a different background would have been more effective in bringing out the figure. Such was the case in a *Jeanne d'Arc* window designed by Mr. Frank D. Millet. The substitution of a light for a dark sky brought the figure into much finer relief.

When, finally, the effect is considered satisfactory, the fragments of colored glass are removed one by one from the sheet of clear glass, and are skillfully bound together by means of strips of doubly grooved lead. This requires some very nice soldering. When it is completed the lead is tinned in order to protect it from the atmosphere. The spaces between the glass and the lead are then filled with a composition of putty and lead, which sets very rigidly, and serves the double purpose of making the window perfectly water-tight and of preventing any looseness on the part of the fragments of glass. There remains only the provision of a strong, iron-bound frame, and the picture-window, after a development covering many months, is ready to be put in place. The materials for its manufacture have been gathered from many

THE GOOD SHEPHERD.

sources, and the skill of many hands and brains has united to bring them into suitable community. The functions of artist and artisan have been fulfilled. Now they give place to the office of the critic.

The result of this co-operative labor is much more than mere decoration. It is a work of art whose capacity for deep and beautiful expression we are only beginning to realize. Standing before such a picture-window, one feels anew the spiritual element in all beauty. The thought that has fastened itself to a sunbeam seems singularly alive and pervasive.

To one who is familiar only with the chromatic efforts of the "glass sinners" this praise may seem extravagant; but, as we love painting in spite of some pretty poor chromos, and statuary in the face of popular domestic groups turned out by the gross, so is it possible to warmly admire the window of real merit while we deplore its unhappy imitator. At its best one can imagine few objects more beautiful. The varying light and the purity of color in art work of this character are a source of lively pleasure. They appeal to a sentiment which, when present at all, is apt to be a dominant one. Those who entertain it turn away regretfully from so beautiful and so luminous a picture.

## THE CONVICT-ISLAND OF BRAZIL—FERNANDO DE NORONHA.

By JOHN C. BRANNER, Ph. D.

THE island of Fernando de Noronha* is in the South Atlantic Ocean, two hundred and fifty miles south of the equator, about two hundred miles northeast of Cape St. Roque, and near the track of vessels plying between European ports and those of South America lying south of the cape. It belongs to Brazil, and has long been used by that Government for a penal colony. In 1876, when a member of the Imperial Geological Survey of Brazil, I visited this island for the purpose of studying its natural history and mapping it. It was no part of my official duty to criticise the administration of the affairs of the island as a prison, yet it was but natural that I should take a deep interest in this administration, and should inform myself, whenever occasion offered, regarding the methods employed in dealing with a class of persons so new to me. The commandant and other officers spoke freely whenever they addressed me in regard to administrative meas-

* The name is also erroneously written—Fernam de Loronha, Fernão de Noronha, Fernando Noronha, Ferdinando Noronha, Fernand de la Rogne, etc.

ures, while from the prisoners themselves I learned much of the operation and results of these measures.

It will throw some light upon the character of the inhabitants of Fernando de Noronha to know how crime is looked upon by the common people in Brazil, and I can not better show this than by relating a bit of personal experience.

I had the misfortune at one time to wound a Brazilian laborer —in his dignity. He thereupon threatened to take my life, and was by no means careful to keep his resolutions to himself. As the carrying out of such a determination upon his part would have caused me much inconvenience, I called upon him in person, with the purpose, if possible, of dissuading him. I found that he did not look upon the condition of a criminal with dread at all. He told me frankly that, if he should succeed in carrying out his designs, he knew perfectly well what his career would be. "At present," said he, "I am obliged to work for a living; if I am sent to jail, my living will be furnished me, and I shall have nothing to do. If you are dead, there will be no one to appear against me in the courts as my accuser, and in the course of a year or less I shall be set free, well rested, and with the reputation in the community of being a man of courage."

In this case I saw to it that he had the opportunity of enjoying the coveted *otium cum dignitate* in jail without having to commit a crime. But in a country where wrong-doing sets so lightly upon the conscience, and where it so frequently goes altogether unpunished, the criminal class is large, as we should expect, though through a lax administration of the laws but a small part of it ever reaches Fernando. I refer to this phase of the subject because, in order to understand the class of people inhabiting Fernando de Noronha, it is necessary to know something of the source of supply.

The convict-island is visited once a month by a small steamer from Pernambuco. On one of the vessels I took passage, furnished with the usual and indispensable official letters of introduction from the President of the Province of Pernambuco; and, after a voyage of two and a half days, anchored in front of the village in which the commandant or governor of the island lives. Arrived at the anchoring-ground—for there is no wharf or pier, and no small boats are allowed on the island—I could see upon the beach about seventy-five half-naked men tugging at a huge two-storied raft, trying to get it into the water. When this was launched, a large cable was secured on shore, and the great raft was paddled slowly in our direction, telling out the cable, the other end of which was finally made fast to the steamer.

The personal baggage, five or six newly arrived convicts with their guards, and myself and servant, were placed on the upper

story of this peculiar craft, and it was then drawn in near the shore by means of the cable. When we struck bottom I was taken on the wet, slippery, naked back of a convict, who waded ashore and deposited me on the dry beach. Everybody and everything landed from the raft, I was escorted by a man who took me in charge, and whom I afterward found to be a convict directed by the commandant to look after all persons and all things landing, and escorted up the very steep hill, through the well-paved streets of the village, to the house of the commandant, closely followed by the newly arrived convicts under guard.

The commandant I found to be a very aged man, an officer in the regular Brazilian army. His thin gray hair was cut close to his angular head, and his mustache was white with age and yellow with tobacco-smoke. He received me indifferently for a Brazilian, for, though he placed the island itself and everything and everybody on it at my orders, in true Brazilian style, I could see that there was a coolness beneath his politeness. I afterward found that this was due to a suspicion that I had been sent here by the Government upon some secret mission. This impression removed, he became heartily kind to me, and did all in his power to aid me in my work. He gave me a room in the official residence, the seat of honor at his bountifully served table, and a motley crew of convicts for servants, while the slender resources of the island were in reality placed at my disposal.

At the house of the commandant certain ones of the convicts were admitted freely and treated with more or less indulgence. The chief amusement of the officers of the garrison and their wives was to assemble during the evening around the big table in the reception-room in the official residence, and there to play kino. On such occasions (and this game was played every evening during my stay save two) there were from one to five privileged convicts standing about the room as lookers-on, and some of them were even invited to take, and did take, part in the game. At meal-time they frequently dropped into the dining-room, and gently encouraged the old governor to scold them while at his meal. Some of them, being ready conversationalists, were permitted to talk freely, and were even asked, before the meal was over, to take places at the great dining-table; and, though they always sat below the wine, were generally given some sweetmeats or a cup of coffee at the end of the meal.

Among the convicts thus specially privileged about the house was a tall, handsome Italian, apparently a man of education. He spoke, besides his native language, Spanish, German, some English, and Portuguese almost perfectly. I asked his story of the son of the commandant, who also told me the personal history of many of these men, and learned that he had killed five persons in less

than five minutes, including the young lady to whom he was betrothed, because she had followed the advice of her father and mother, and had broken off the match upon the morning of the day on which they were to be married. As the narrator ended the story, which was told in all its dreadful details, he remarked, "And so you see he was almost justified."

This instance, which is simply an example out of a great many of a more or less similar nature, is mentioned for the purpose of illustrating one of the most deplorable facts connected with the administration of the affairs of the island—that is, the inevitable influence upon its inhabitants of familiarity with crime. This young man, neither a criminal nor an executive officer, had come, by constant contact with criminals, to look upon crime with pity in some cases, and with actual approval in others.

It is not my purpose to repeat here in detail the stories of the lives of these people, for those stories are sensational to the last degree, and should be looked upon simply as so many facts in a social study. But, while some of the convicts were indulged, others were treated with unnecessary severity, which merged into cruelty. This unequal justice, or rather the disproportionate punishment meted out to offenders, and over which the officers in charge had full jurisdiction, was, in itself, demoralizing to the great body of convicts, and held out no hope or encouragement to any one to be anything short of the most abandoned criminal. No effort was made to fit the punishment to the crime. Flogging was the one remedy for everything, and, as it always took place in the presence of the assembled prisoners, this became a new element of degradation to the entire community. A convict having stolen a pig, was sent for and flogged. The very next morning the commandant was called to the front door, and there on the veranda stood a man horribly mangled by an assassin. "What does all this mean?" said the commandant. "Fulano has killed me," said the convict. "Away with you to the hospital"; and, turning to an officer, he continued, "and bring Fulano here to me." And Fulano was brought and flogged.* The influence of such a system of treatment upon the less depraved classes of criminals may readily be imagined.

* I undertook to witness a flogging once, but, as I did not get through it with credit to myself, the less said of that occasion the better. I was informed by one of the officers that, not long before, one convict had been so severely flogged that he had died of his injuries. In the light of these facts it is interesting to read article 179, section 19, of the Brazilian Constitution of 1824. It is as follows: "From this time forth flogging, torturing, branding, and all other cruel punishments are abolished." It should be added, however, that in 1879, since my visit to Fernando de Noronha, the Minister of Justice of the Brazilian Empire has directed that corporal punishment of the convicts should cease.

*Postscript.*—The "Proceedings of the Royal Geographical Society" for July, 1888, contains an article upon Fernando by a gentleman who visited that place in 1887. The convict

The amusements of the inhabitants were cock-fighting and kino. I suggested to the commandant that cock-fighting was a degrading pastime for his *protégés* (I did not mention kino, because that was the favorite amusement in his own house). His reply was: "I know it isn't good; but then—"

Often in private conversation these men would discourse to me upon the moral and social condition of their companions. On such occasions I frequently heard such expressions as these: "You must look out for Fulano." "Some people have no consciences." "The Lord deliver us from a convict!" "These convicts are a bad set, I tell you!"

Society was as varied among these men as in other parts of the world. There were all classes and grades, though they all met on the common level of crime. Social distinctions among them were based upon money first, and second, other things being equal, upon the nature of the crime committed, certain crimes being regarded as indicative of courageous manhood.

While about my work one day, my attention was attracted by a young man who was posing near by and disdainfully watching me. He was not more than twenty years of age, good-looking, and well dressed. A fine felt hat sat jauntily upon the side of his head, and he wore a blue cloak, the bright red lining of which he displayed to good advantage by tossing it back over his shoulder. I saw that he was a type, drew him into conversation, and finally asked him for what he was sent to Fernando. Bridling up and throwing back his shoulders, he struck his left breast with his right hand closed, as if upon a dagger, and exclaimed proudly, "Mor-r-rte!" (murder).

Many of the prisoners were known among themselves by what seemed to be very odd names, and I learned that they were nicknames taken from some circumstance connected with the crimes they were expiating. Sometimes there was a ghastly sort of humor about these names. One, who had murdered a priest, was called "*O Padre*," the priest; another, who had murdered a man for his money and had found but half a *pataca* upon him, was called "*Meia Pataca*," half a pataca, about sixteen cents; another, for a similar reason, was called "*Quatro Vintens*," four cents.

These are simply instances of how the minds of these people dwelt constantly upon crime, how they admired crime, and conse-

system is there spoken of as "almost unique in its excellence," and a convict of seventeen years' standing is called "our dear old guide." The great number of verbal errors in the article lead one to conclude that its author knows little or nothing of the Portuguese language, without the easy command of which he could get no clear insight into the working of the convict system. He states also that one of the prisoners was flogged during his short visit. Flogging continues, therefore, in spite of the order of the Minister of Justice made in 1879 and referred to above.

quently gravitated toward it. About their work in shop or field, the daily bread of their minds was to think and talk of crime in every shape that diseased minds and perverted natures can conjure it up. One would entertain his companions by detailing to them the story of some crime committed by himself, or of which he had knowledge, while every one listened attentively, like so many experts. The story ended, criticism began, and each one would indicate what he considered the weak points in the plan and its execution, and would suggest improvements here and there. One story always led to another, and, as might be expected, minds accustomed to this highly seasoned food soon rejected all other.

The total population of the island at the time of my visit was 2,562, about seven hundred of whom were not criminals, but the wives and children of convicts who were, by necessity or choice, accompanying husbands or parents in their exile and imprisonment. As already stated, the great majority of the convicts had been sent here for murder, and belonged to a low, brutal type of men. The general tendency of this intermingling of the innocent with the criminal, and of the less depraved of the convicts with the worst, is to reduce all to a common level, and that level the lowest.

In the ordinary experience of life a man seldom or never sinks so low that there is no hope for him, hope both subjective and objective, but of the worst of these convicts this is not true. The only priest of the island, after years of labor, went through his sacred duties in a perfunctory manner, for, as he gave me to understand, he had long since come to realize that the seed he sowed fell into the fire. Speaking to him one day regarding the peculiar charm of the place, he replied: "Ah me! I can't see these things now, for though it is, externally, all that you see and say of it, this quiet, this seclusion, this beautiful and bountiful nature are turned by man into a stifling, suffocating hole—a stench in the nostrils of God."

But fortunately the attractiveness, the beauty and grandeur of nature as seen in the delightful landscapes, the tropical vegetation, the peculiar fauna and flora, the majesty of the ocean, the violence of the tempests, the charming caprice of clouds and sunshine, prevent one from brooding too long over these dark pictures of human depravity, while the convicts themselves not infrequently come like quaint figures in the foregrounds of beautiful pictures. But to see this beauty one must look through the eyes of a lover of nature.

For the true-hearted naturalist there is no such thing as solitude, but to those who see but little or nothing companionable or intelligible in landscapes, in forests and fields and oceans, and above all to the ignorant, Fernando de Noronha doubtless seems

a lonely, desolate, and forbidding place. A phrase in common use among the inhabitants of that island expresses better than anything else could the general feeling of the prisoners in regard to their isolation and separation from all that is interesting and attractive to them on earth. For them, and in their minds, the earth is divided into two parts, one of which—that inhabited by themselves—is known as Fernando, the other part is known and usually spoken of as "the world." This term was in constant use, and I frequently heard among them such expressions as these: "When I was in the world," "This came from the world."

It is often asked whether there was not great danger in trusting one's self with men so many of whom were known to be desperate characters. This question can not be answered for every one at the same time, because whether there would be danger would depend almost entirely upon how one conducted himself. The commandant was so solicitous regarding my personal safety, when I first began my work on the island, that he wished to send an escort of soldiers with me in order to secure me against possible danger, and it was with difficulty that I persuaded him to allow me to dispense with such cumbersome attendance.

When working in parts of the island remote from the village I sometimes found it necessary to pass the night in the huts of the convicts. At such times I was never treated otherwise than with respect by them, and I never had the least reason to feel disturbed about my personal security. One day, when alone in my room in the house of the commandant, a tall mulatto came to the door and handed me a begging letter, written in very poor Portuguese. In this letter he called himself my "afflicted fellow-countryman." Addressing him in English, I found that he had been an American sailor, and was here for murder. As he seemed eager to be in my service, I employed him; but, when I informed the commandant of the arrangement, he endeavored to dissuade me from having him about me, assuring me that he was the most unconscionable, incorrigible criminal in the entire settlement. In spite of these protests, I took my "fellow-countryman" with me, and for three days his services gave entire satisfaction. At the end of that time he was discharged for the only impoliteness shown me during my stay upon the island.

Abandoned and unscrupulous as so many of the convicts were, I found them susceptible to the ameliorating influences of fair wages and reasonable treatment—a susceptibility due to some extent, perhaps, to the general absence of considerate treatment in their present lives—and when I left Fernando some of those whom I had employed manifested their good-will toward me in a way of their own. On the morning upon which the steamer was to sail for Pernambuco, my collections and baggage had all, as I thought,

been placed on board, when, previous to my taking leave of the officers and their families, I was called to the door by a visitor—one of my convicts. He stood barefooted and uncovered, his warped, reddish-brown hat held in his left hand behind him, his coarse shirt of dirty cotton cloth hung, in the customary fashion, outside his coarse trousers, and these were rolled half-way up his bare, brown legs. He laid his right forearm across his forehead like a timid child, and when asked, "And what is it, Feliciano?" he said: "My patron, pardon me, eh? but it is all I have. Here are some squashes I have brought for your lordship to take back to the world with you," and he pointed with his leather hat toward six enormous squashes that lay upon the floor of the veranda, and which he had brought during the night from a distant part of the island. My embarrassment may be realized in some degree when I say that I knew that, excepting only the clothes he wore, these six squashes were the sum total of that poor fellow's earthly possessions. I knew, too, how serious an offense it would be to decline his present, so there was nothing to be done but to accept it and take his squashes "back to the world" with me. If the matter had ended here, it would have caused me no serious inconvenience; but, before the steamer sailed, a whole wagon-load of squashes had accumulated on the floor of the veranda, and all of them had to be accepted and taken away.

When the time for my embarkation had arrived, the officers of the station accompanied me to the beach, where they bade me farewell in that affectionate and touching manner so characteristic of Brazilian gentlemen. After these had withdrawn, there came about me seven men with rough clothing—what there was of it—rough, hard hands, and hard faces. They stood uncovered, and, without speaking a word, one after another held out to me a thick, horny right hand. One of them then stooped and took me on his back, and, wading out to the great raft, left me to be transferred to the steamer. That afternoon I saw this lofty, beautiful, but sin-cursed Fernando sink slowly into the ocean; and the last sight I had of it was when, as the sun went down, it touched with crimson and gold a cloud-banner that streamed away like a pennant from the summit of its majestic peak.*

* In view of what I have said of the moral condition of the convicts confined on this island, it is but just that I should add that in the year following my visit, that is, in 1877 the Imperial Government of Brazil appointed a commission for the purpose of elaborating a prison system for the country. The President of the Province of Pernambuco held out to the Legislative Assembly of that province the hope that Fernando de Noronha would not be overlooked by this commission. Said he, "The grave social, economic, and moral questions here involved will be settled." It is to be hoped, too, that the transfer of this penal colony from the Department of War to that of Justice will also be conducive to a better prison system.

# THE STRANGE MARKINGS ON MARS.

By GARRETT P. SERVISS.

IN the whole planetary empire of the sun there is but one body, if we except the moon, whose actual surface can be satisfactorily examined even with the most powerful telescope. The broad disk of Jupiter presents a most inviting and splendid sight; but it is apparent that we are not looking at the solid shell of a planet, but at a vast expanse of thick clouds, surrounding and concealing the planetary core, and reflecting the sunlight from their shifting surfaces. Saturn presents a somewhat similar appearance, modified by greater distance. Uranus and Neptune are so nearly beyond the present reach of telescopes, so far as the phenomena of their disks are concerned, that we know almost nothing of their surface appearances. Some observations of Uranus, however, indicate that it presents the same equatorial parallelism of exterior markings that characterizes Jupiter and Saturn; and so we may infer that what we faintly discern on its disk are the outlines of cloud-masses, enveloping the planet, and drawn out by the effects of its rotation into belts and streaks. Coming to the nearer planets, we find that Venus, superbly brilliant to the naked eye, and consequently, it might naturally be thought, a promising object for telescopic scrutiny, is nevertheless the most disappointing of all the planets when viewed with a telescope. The splendor of its luminosity in itself forms an obstacle to the study of its surface, where flitting glimpses of shadowy forms and brilliant spots only serve to excite the keenest curiosity. With respect to Mercury, our knowledge is equally unsatisfactory. The surface of the moon, of course, has been well studied, as such maps as those of Beer and Mädler, Neison and Schmidt sufficiently attest. But, after all, the absence of the faintest indication of life robs the wonderful lunar landscapes of a large share of the interest that would otherwise attach to them.

Finally, we look at Mars, and here at last we find a globe whose true surface we can inspect, and which at the same time possesses an atmosphere and other concomitants of vital organization. Since Mars has been selected by more than one astronomer as the probable abode of life (and perhaps the only one besides the Earth in the solar system), and especially since a discussion of the markings seen upon the planet necessarily involves the physical features upon which the theory of Mars's fitness for inhabitation rests, it will be well to recall here the principal facts that have been ascertained respecting that interesting orb.

The diameter of Mars is 4,200 miles, or only some 240 miles

more than half of the mean diameter of the Earth. The density of the planet is rather less than three quarters of the density of the Earth, or about four times the density of water. The force of gravity upon its surface is less than two fifths of that upon the Earth; more accurately, 0·38. That is to say, if a man from the Earth could visit Mars, he would find that his weight had diminished almost two thirds. Members of terrestrial fat men's clubs could become agile dancers by simply going to Mars. This feebleness of the force of gravity must, it is clear, have an important effect upon the organization of any forms of life that may exist upon Mars, whether animal or vegetable. The mean distance of Mars from the sun is 141,500,000 miles, that of the Earth being 92,900,000. The length of Mars's year is six hundred and eighty-seven days. Its day is only forty-one minutes longer than our day upon the Earth. The inclination of its equator to the plane of its orbit differs but slightly from that of the Earth. But when we come to consider the eccentricity of its orbit, we find a decided difference between the Earth and Mars. The Earth's orbit is so nearly a circle that its greatest and least distances from the sun differ by only 3,000,000 miles, while the orbit of Mars is so eccentric that that planet is 26,000,000 miles nearer to the sun at one extremity of its orbit than at the other. It follows that, while Mars receives, upon the whole, less than half as much light and heat from the sun as the Earth gets, yet that quantity is variable to the extent of about one third of its greatest value—in other words, the sun gives Mars half as much again heat at its perihelion as it does at its aphelion. It is hardly necessary to point out the important climatic effect of such a variation. Another remarkable resemblance between the Earth and Mars comes in here. Just as on the Earth, the summer of the northern hemisphere of Mars occurs when the planet is farthest from the sun and its winter when nearest. The effect, as Mr. Proctor has pointed out, tends to equalize the temperature of the seasons in Mars's northern hemisphere, but to exaggerate their difference in the southern hemisphere.

We may dwell for a moment upon this last-stated peculiarity, for it is exceedingly interesting in its suggestiveness. Having summer occurring in the southern hemisphere of Mars at the planet's perihelion, and winter at its aphelion, we should find there a most remarkable disparity both in temperature and in the brilliancy of daylight between the two seasons. The difference would be the sum of the effects produced by the greater or less distance of the sun and the variation in the inclination of its rays to the surface of the planet. Since the first cause alone would produce an inequality amounting, in the extreme, nearly to the ratio of 3 to 2, it is evident that the addition of the second would

increase the difference to such an extent that the seasonal changes might be fatal to all higher forms of life. We have only to recollect how powerful the effect of the comparatively moderate variations between the seasons of our own planet is upon the human organism in order to understand what must be the condition of things in the southern hemisphere of Mars, where the passage from one season to the other presents the succession of violent winter cold, accompanied by days of gloom and faint sunshine, followed by a blazing summer, with the sun hanging overhead, visibly increased in apparent size by its approach. Telescopic observations show clearly by the great variation in the extent of the polar snows how extensive is the effect of these changes upon the surface of the planet. In the hot summer the snows rapidly retreat toward the pole, and even leave the actual pole itself bare of snow, showing that upon Mars, as upon the Earth, the center, or pole, of greatest cold (at least in the southern hemisphere) does not coincide with the geographical pole of the planet. Then, with the on-coming of winter, the march of the snows begins and they rapidly advance further and further toward the equator, spreading over the antarctic regions until another change of season brings back a flaming sun to melt them away. It should be added that, as Prof. Young has remarked, the climate of Mars, upon the whole, appears to be much milder than we should naturally have expected in view of its distance from the sun.

Bearing in mind these general facts about the size of Mars and its position in the solar system, we shall now proceed to the discussion of its surface phenomena as revealed by the telescope, merely pausing to remark that the atmosphere of Mars is apparently less dense than that of the Earth, and that the spectroscope has demonstrated the presence of watery vapor in it.

The little telescope of Galileo, which had enabled him to discover the phases of Venus, the satellites of Jupiter, the mountains of the moon, the existence of Saturn's ring, and "vast crowds of stars" in the Milky Way, was not powerful enough to show him the markings that diversified the disk of Mars. The earliest drawings of Mars that have come down to us were made by Fontana, in Italy, in 1636 and 1638. They contain very little detail, the best representing the planet simply with a darkish spot in the center of the disk. Twenty odd years later Huygens made much better drawings, and then the work was taken up by Cassini, Maraldi, and others, with the cumbersome telescopes of the time, the most powerful of which consisted of an object-glass suspended high in the air by means of a long pole or other support, while the eye-piece in the hand of the observer on the ground was, with infinite difficulty, brought and kept in line with the optical axis of the instrument. One of these telescopes was no less than three

hundred feet in length, the great length being necessary in order to avoid, as far as possible, the chromatic aberration of the single lenses of which object-glasses were then made! Considering the enormous difficulties under which they labored, the results attained by these early observers are astonishing. The delineations of the planet's surface made by Huygens and Hooke were sufficiently exact to be used by modern astronomers in ascertaining the rotation period of the planet within a fraction of a second, while Cassini's observations enabled him to calculate that period with an error of less than three minutes. In fact, Huygens saw enough to suggest to his penetrating mind the existence of an analogy between the surface of Mars and that of the Earth.

In 1666 Cassini made a drawing of Mars, which is reproduced in our cut, showing in rough outline a feature of the planet's surface which has since become well known under the names of Kaiser Sea and the Hour-glass Sea, the last being suggested by its shape. Directly underneath Cassini's drawing I have placed, for the purpose of comparison, a picture of Mars made by Herschel in 1780, and showing the same sea, but with much more detail. Allowing for the difference in the position of the disk (for the two drawings were plainly not made at precisely the same period of the planet's rotation, nor at the same inclination), and also considering the great superiority of Herschel's telescope, the resemblance is sufficiently striking to show that the two observers were looking at the same feature of the planet, and that it was a permanent marking on the disk. The south polar ice-cap is conspicuous in Cassini's drawing.

A word, by the way, in regard to the "seas" and "ice-caps" of Mars. The general color of the planet is ruddy, some observers say rose-color, and this hue is plain in naked-eye observations. But the telescope shows that the disk, instead of being uniformly red, although that tint predominates, is divided into streaks and patches of varying hue. The reddish regions are regarded as being the land-surfaces of the planet, while the dusky or greenish parts are looked upon as probably oceans or seas. At the poles there are seen white caps which, inasmuch as they increase in size when it is winter and decrease when it is summer in their respective hemispheres, are regarded as the arctic and antarctic snow regions of Mars.

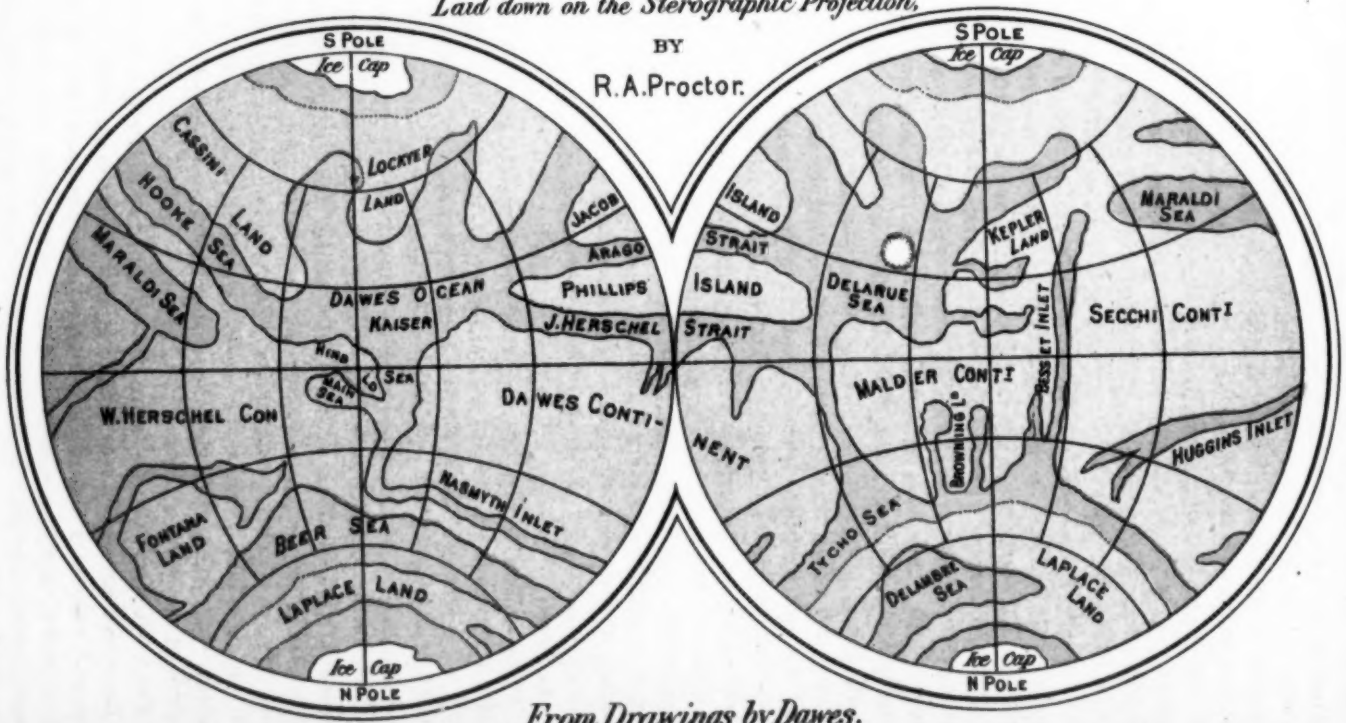
From the time of Herschel the study of the surface markings of Mars was prosecuted by many observers with more or less success, and Beer and Mädler, those indefatigable portrayers of celestial scenery, made a chart of Mars; but it was not until some twenty years ago that a reasonably full and satisfactory map of the red planet was produced. Then Mr. Proctor, using the drawings of the "eagle-eyed" Dawes as the basis of his work, con-

# A CHART OF MARS,

*Laid down on the Sterographic Projection,*

BY

R. A. Proctor.




*From Drawings by Dawes.*

structed a chart of Mars, which was published in his most famous book, "Other Worlds than Ours," and which is reproduced with this article. The most hasty comparison of this chart with the drawings of Cassini and Herschel shows that an enormous advance had been made since the time of the latter, incomparably greater, in fact, than had been accomplished in the hundred and more years that elapsed between Cassini and Herschel. Yet if we should place any single one of Dawes's drawings side by side with those of the old observers, the difference would not appear by any means so striking, for, the reader must recollect, Mr. Proctor's chart was constructed by inspecting and comparing twenty-seven of Dawes's sketches, representing the planet at different periods of its rotation, so that all sides of it were successively viewed in the best position for observation. If we had an equally numerous series of Cassini's, or preferably of Herschel's sketches, made in a similar manner, we should probably be able to construct from them a chart which, while it certainly would be greatly inferior to Proctor's in its details, would nevertheless make it clear that the earlier observers saw many of the principal markings that are shown in the more modern map.

OLD DRAWINGS OF MARS.

Still more detailed charts of Mars followed that of Mr. Proctor, notably those of M. Flammarion, and Mr. Green, the latter being a very beautiful work based upon a series of splendid drawings made by Mr. Green in the island of Madeira. But no very considerable advance was made in areography, as the geography of Mars has been called, until Signor Schiaparelli published the results of his surprising observations made during the very favorable opposition of Mars in 1877. Although Schiaparelli has repeated these observations again and again, and they have been confirmed, in part at least, by several able observers, there is a disposition in some quarters to cast doubt upon them, and to ascribe them to the effects of optical illusion or some other hallucination. Considering the wonderful character of these observations, and the immense advance that they constitute in the study of the surface of Mars, there is, perhaps, the shadow of an excuse for some incredulity about them. Yet I think the reader will be

convinced, after inspecting Schiaparelli's map, and hearing the story of what he has seen, that to throw discredit upon the substantial accuracy of his observations, marvelous though they may appear, is to do serious injustice to the great Italian astronomer.

And, now, what is it that Schiaparelli has seen on Mars? Many readers will probably at once answer "canals," for the fame of "Schiaparelli's canals" has become wide-spread, and that very word has, perhaps, done as much as anything to foster incredulity in regard to these discoveries. It is true that Schiaparelli himself suggested the name canals to describe the strange lines that he found traversing the continents of Mars, and forming, as it were, a network of intercommunication between its seas; but, at the same time, he indicated that that name was simply to be taken, for lack of a better, as descriptive of their general appearance, and not as implying that they were canals in our sense of the word. Of course, the term was at once restricted, in popular acceptation, to its terrestrial sense, and there have not been wanting speculations about the engineers who constructed those wonderful canals on Mars! Mr. Proctor rather helped on this fanciful interpretation of Schiaparelli's discovery by throwing out the suggestion that, owing to the slight force of gravity on Mars, we should not be too hasty in setting limits to the engineering achievements of the giants who might dwell upon that planet!

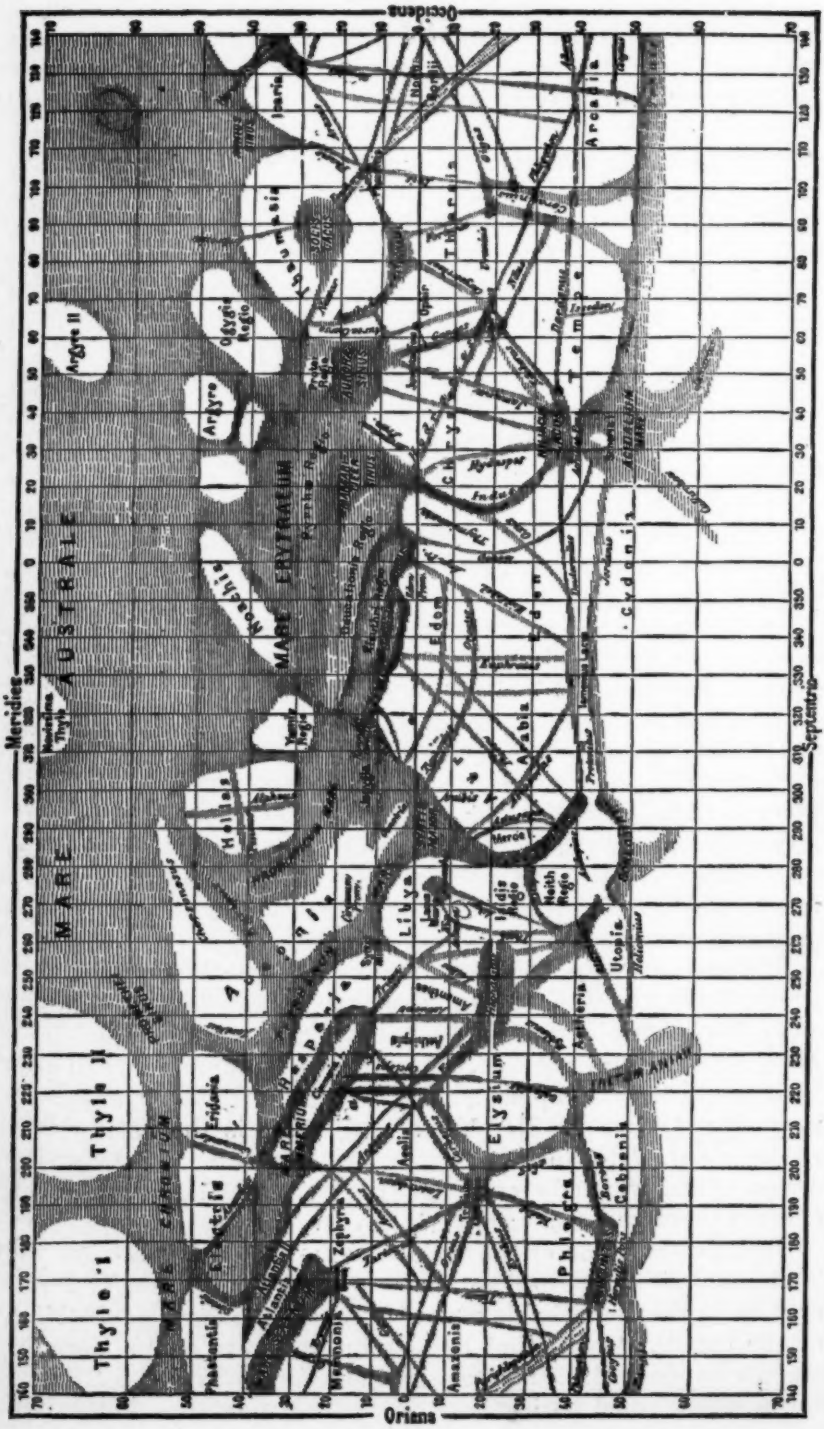
But, setting aside the manifestly false analogy which would make of Schiaparelli's "canals" actual artificial water-courses, we shall find that the real facts are not the less wonderful and suggestive of interesting reflections. Schiaparelli's first observations of these singular objects were made, as I have already said, during the opposition of Mars in 1877. It will be remembered that it was at that very same opposition that Prof. Hall, using the great Washington telescope, at that time the most powerful refractor in the world, discovered the moons of Mars. Yet Prof. Hall saw nothing wonderful or very unusual on the disk of the planet; and Schiaparelli, on the other hand, failed to discover the little moons. Hall's discovery was made in August; Schiaparelli's began in September. All this is very singular; but it seems still more strange that, while the moons of Mars, having once been discovered, were afterward seen with comparatively small telescopes, the canals have never been seen with the great glass at Washington, and that only three or four observers besides Schiaparelli have ever seen them. In the last annual report of the Naval Observatory for the year ending June, 1888, it is stated that the great telescope had been in constant use, under the charge of Prof. Hall, and that the surfaces of both Saturn and Mars were constantly and carefully examined, and drawings made from time to time. In the case of the latter planet the

canals of Prof. Schiaparelli, though specially looked for, both during and after the opposition, could not be made out. At the very same time the canals were visible not only to Schiaparelli, but to Perrotin and Terby, and, as we shall see further on, some very remarkable phenomena connected with them were observed. At the Lick Observatory, too, they saw the canals, though they did not perceive all the details and peculiarities noted by Schiaparelli and Perrotin. How shall we account for these remarkable discrepancies? I do not for a moment think that they shake the substantial accuracy of the Italian observations. No doubt a clew to the explanation is furnished by what Schiaparelli has recently said of the difficulty of seeing the objects he has described: "On the rare days when these extremely difficult observations are possible, the period of good telescopic images does not last, ordinarily, more than two or three hours during the twilight, or the commencement of night. . . . I have found by experience, at Milan, that one can hardly hope to have an atmosphere sufficiently good during more than eight or ten evenings (during an opposition); sometimes even entire months pass without one's being able to make a satisfactory observation. Much rarer still are evenings of perfect images, those in which one can employ the whole power of an instrument like our Merz equatorial of eighteen inches."

And this is said of the Italian sky, which has long been famous for the steady views that it gives of the heavenly bodies. What could be expected, then, of the mist-haunted atmosphere of the Potomac flats through which the watchers at our Naval Observatory must strain their vision? At Mount Hamilton they have atmospheric conditions that rival those of Italy, and therefore it was to be foreseen that they could hardly fail to confirm the existence of Schiaparelli's strange markings.

It should be said, before proceeding, that while the great majority of the canals have been seen only by Schiaparelli himself and a few other observers, there are two or three which had been recognized, though not under their present designation, and perhaps not in their complete extent, before the Italian astronomer made his discovery. Notable among these is the narrow arm running out of the Kaiser Sea, or Syrtis Magna, as Schiaparelli names it, and which he calls the Nilosyrtis. Herschel, and even earlier observers, seem to have noticed this.

But the detection of the dark lines called canals was only the beginning of Schiaparelli's singular discoveries. The next development in this remarkable series of observations was the *doubling* of the canals. Those that he saw in 1877 were simple lines, or narrow bands, and, strange as their appearance was, the liveliest imagination could hardly have prefigured their aspect at subse-




SCHIAPARELLI'S MAP OF MARS.

quent oppositions. In 1879 Schiaparelli noticed that the canal which he calls *Nilus* (see his map) was double, or consisted of two streaks running side by side, and perfectly parallel. This observation was made shortly after the time of the vernal equinox on Mars.

"These two regular, equal, and parallel lines," he says, "I confess profoundly surprised me, all the more because a few days before, the 23d and 24th of December, I had carefully examined that same region without discovering anything of the kind. I awaited with curiosity the return of the planet in 1881 in order to see if an analogous phenomenon would present itself in the same place, and I saw the same thing reappear on the 11th of January, 1882, one month after the vernal equinox of the planet, which had occurred on the 8th of December, 1881. The duplication was still plainer at the end of February. At this same date, the 11th of January, another duplication had already been produced, that of the middle section of the canal of the *Cyclops* at the edge of *Elysium* (see map). Greater still was my astonishment when, on the 19th of January, I saw the canal *Jamuna*, which was then in the center of the disk, composed very plainly of two parallel straight lines traversing the space which separates the *Niliacus Lacus* from the *Aurorœ Sinus*. At first I thought it was an illusion caused by fatigue of the eye and by some new kind of strabismus; but there was no resisting the evidence. From the 19th of January I simply went from surprise to surprise; the *Orontes*, the *Euphrates*, the *Phison*, the *Ganges*, and most of the other canals showed themselves very clearly, and indubitably divided in two."

It is not a matter for surprise that this announcement of Schiaparelli's, coming upon the heels of his original discovery of the canals as single lines, which in itself was sufficiently remarkable, caused still greater doubt to be entertained of the correctness of his observations. It seemed to many easier to believe that a distinguished astronomer and practiced telescopist had been misled by some deception of the eyes, some optical trick of his instrument or of the atmosphere, than that the globe of Mars was covered, over the larger part of its surface, with a network of lines, apparently connected with the water-system of the planet, and that, at certain times, these lines, canals, or water-courses, or whatever they might be, were doubled up throughout their whole extent. Even the positive assurance of the celebrated astronomer, "I am absolutely certain of what I have observed," could not banish all doubt. The manner in which the doubling of the canals was brought about seemed most mysterious, and added to the apparently dubious character of the whole occurrence. Schiaparelli declared that sometimes he was able to perceive precur-

sory symptoms of the change. A light, hardly visible shade would make its appearance, extended alongside one of the canals. In a few days only a series of whitish spots would appear there. A day or two later the perfect double of the canal would be seen with absolute distinctness lying beside the original, exactly parallel with it, and of equal length, breadth, and depth of color.

"One can," says Schiaparelli, "compare this process of formation to the appearance that would be presented by a multitude of soldiers dispersed without order who, little by little, should arrange themselves in ranks or in columns; so that we are here dealing with formations unknown on the earth, determined by the geographical configuration of the ground, and capable of reproducing themselves periodically in the same places and under the same aspects."

These canals (we must continue to call them by that name for lack of a better) vary in length from a few hundred miles to two or three thousand, while their width is seventy-five or eighty miles. When they become double, the distance between the twin canals is from two hundred and fifty to five hundred miles.

The Italian astronomer's later observations have again and again confirmed the results of his earlier ones. During the oppositions of 1883–'84, 1886, and 1888, under somewhat varying conditions, and with different degrees of visibility, yet always unmistakably, he has seen not only the canals, but the strange phenomenon of their doubling or gemination. The character of the appearances has been always the same, but in details they have differed.

Let the reader compare Schiaparelli's map with the chart of Mr. Proctor, and he can not fail to be impressed by the enormous advance in the matter of minute detail exhibited by the former. Apparently more has been learned about the surface of Mars during the past twelve years than was learned in the previous two hundred years, and the greater part of this gain is the work of a single observer.

While it is more or less idle to speculate on the nature of these singular objects appearing on a globe that never approaches the earth nearer than about forty millions of miles, and that ordinarily is very much farther away, yet it is impossible to avoid indulging a natural curiosity to know what they are. It is known that all the features of Mars's globe are more or less changeable, though upon the whole they preserve the same general aspect, and Schiaparelli declares that in the case of the canals the changes are not only extensive but periodical. It has generally been believed that the variations of appearance in the larger features of the disk were owing principally to atmospheric causes. Large regions of the planet have, at times, been seen

apparently hidden under a veil, the gradual withdrawal of which has again revealed their well-known contours, and in such cases the conclusion has seemed irresistible that what had been observed was the formation and subsequent dissipation of vast cloud areas concealing or obscuring the outlines of continents and seas beneath them. So the indistinctness near the edges of the disk and the altered appearance of the planetary features there have been partially ascribed to atmospheric influences as well as to the effects of perspective. Whether the observed changes in the appearance of the canals can be ascribed to similar causes is a question which can not yet be solved. Schiaparelli appears to think that they are principally due to something which occurs on the surface of the planet itself, and which something, in its turn, depends upon the changes of the seasons.

In order to form any opinion whatever upon this question it is necessary to examine a little more closely the varying aspects of the canals. Their discoverer has noted these four points:

1. A canal may remain *invisible* for a longer or shorter time. This invisibility, he insists, is an actual disappearance of the canal, and is not due simply to unfavorable circumstances of observation. Moreover, he finds here a striking appearance of connection with the seasons. The epoch most favorable for the disappearance of the canals is near the time of the southern solstice of Mars, which, as we have seen, occurs when the planet is nearest to the sun.

2. In many cases, according to Schiaparelli, the presence of a canal begins to manifest itself to the eye in a very vague and uncertain manner, by a slight shading which irregularly extends itself in the direction of its length. This phenomenon is so delicate that, he says, it marks, as it were, the limit between visibility and invisibility.

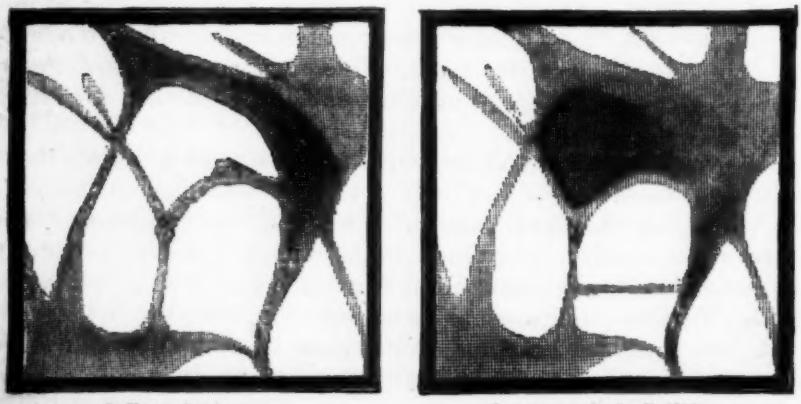
3. Very often the canals present the appearance of a gray band fading out on each side and having the deepest shade in the middle, which may be dark enough to suggest the appearance of a more or less clearly marked line. Sometimes, but rarely, one side of the band alone is nebulous or indistinct, the other being clearly defined. Various other anomalous appearances have been observed.

4. The most perfect type of the canals, and that which their discoverer says he regards as the expression of their normal condition, "is a dark line, sometimes quite black and well defined, looking as if it had been traced with a pen on the yellow surface of the planet." When the canals appear in this form they are very uniform throughout their length, and Schiaparelli says, on the rare occasions when he has been able to clearly distinguish the two edges, one from the other, he has discerned slight sinuosities or scollopings on the borders. He adds that the width of a canal may change with time from a thread, barely perceptible in the

best atmospheric conditions, to a broad black band visible at the first glance.

To all these characteristics must be added, of course, the extraordinary occurrence of the gemination or doubling of the canals. It is natural to suppose that, in such cases, what would be seen would be the apparition of a new canal along side of an old one. That, in fact, is what Schiaparelli described as occurring during his earlier observations; but, during the opposition just passed (1888), he discovered that this was not a general rule, and that it may happen that neither of the new canals, when a doubling takes place, may coincide with the old one. "The identity," he adds, "in the general direction and situation is then merely approximative; every trace of the former canal disappears, giving place to two new lines." Both the width and the distance apart of the twin canals vary in successive seasons.

It would carry us far beyond the limits of space available for this article to enter into a more minute account of Schiaparelli's observation of the many anomalies and changes of appearance which the canals present at different seasons and under varying circumstances. Enough has been said to indicate that it would be impossible to make a map which should show the precise appearance of the surface of Mars at any fixed period, and at the same time contain a representation of all the phenomena which are, from time to time, to be seen there. And it should be said, because this is a matter that has been misunderstood, that Schia-



Ordinary Appearance. Appearance in April, 1888.

CHANGES IN THE ASPECT OF LIBYA.

parelli does not intend his maps to be taken as portraitures of the planet, but simply as sketches showing details of whose existence there is no doubt whatever, but all of which can not be, or have not been, seen simultaneously.

And now there remain yet other remarkable circumstances to be mentioned in order to complete the picture of the surface of Mars,

and some of these may have an important bearing upon the question of the nature of the canals. A glance at Schiaparelli's map shows us the disk of the planet divided into areas of land and water, which are about equal in their total extent. Then crossing the land areas in every direction are the canals, which it will be observed always begin and end either at the edge of a sea, or at a point of junction with other canals. Without varying their direction they cross one another, and in some cases several canals radiate from a single center, which then generally appears expanded into a "lake." In addition there are certain regions which Schiaparelli describes as variable in appearance, or intermediate between the seas and the lands, presenting sometimes the character of maritime surfaces and at other times that of continental areas. Among these are the places marked on the map *Deucalionis Regio*, *Hellas*, and the island called *Cimmeria*. The region named *Libya*, which ordinarily appears as a continental expanse, seems to belong to this class of variable areas, and within the past year it has obtained great celebrity because it was said to have been submerged by an inundation from the adjoining sea. This region is more than 200,000 square miles in area, and lies just under the equator. In May last M. Perrotin, of the Nice Observatory, made the somewhat startling announcement that the continent of *Libya* had disappeared. "Clearly visible two years ago," said M. Perrotin, in his report to the Paris Academy of Sciences, "to-day it no longer exists. The neighboring sea, if sea it is, has completely invaded it. In place of the light reddish tint of the continents of Mars the black, or rather dark-blue, color of the seas has appeared there. . . . In sweeping over the continent the sea has abandoned on the south the region that it formerly occupied, and which now appears with a tint intermediate between that of the continents and that of the seas, a light-blue color, analogous to that of a slightly misty sky in winter."

A look at the accompanying cut will show the change which Perrotin detected. This extraordinary aspect of Libya was first seen in April and lasted into May. In June the "continent" seems to have resumed, or nearly so, its ordinary appearance. Perrotin's suggestion that the change observed was probably periodic appears to be borne out by an examination of former observations of this region of the planet. There was a partial "inundation" of Libya in 1882, and a still more extensive one in 1884, both of which were noted by Schiaparelli, who confirms Perrotin's observation of 1888 in a general way, but does not describe the continent as having at any time completely disappeared. Speaking of its appearance in 1884, Schiaparelli says Libya had a flaky look, as if it had been "covered with innumerable little spots all jumbled together." The suggestion of clouds contained in this

description is very striking, yet Schiaparelli does not pursue the analogy.

All of the regions which possess this semi-maritime character frequently present a lighter color when viewed obliquely, or near the edge of the planet's disk, than when seen near the meridian. This fact seems strongly to suggest the presence of atmospheric phenomena, which may change or modify the appearance of any district covered by them according to the visual angle under which it is observed. The reader has only to take an ordinary terrestrial globe, and, supposing it to represent Mars, turn it slowly around its axis, in order to perceive how the situation of any region with respect to the center or the edges of the disk may influence its appearance. Near the edge the surface of the planet must necessarily be seen through a far greater depth or thickness of its atmosphere than in the center of the disk, and, if that atmosphere contained clouds or mist, of course its opacity would be greater in proportion to its greater depth, and the reflection of light from the mist would give a whiter tone to the features of the planet seen through it. Nevertheless, the cloud theory fails to account satisfactorily for all the appearances that have been so carefully described by Perrotin and Schiaparelli. Yet if it were possible for us to imagine that masses of clouds of some sort could retain, for considerable periods, a fixed or nearly fixed general form and position in the planet's atmosphere, disappearing and reappearing in the same localities according to the seasons, and occasionally extending their outlines or slightly shifting their positions, then we might be able to account for such phenomena as those presented by Libya, without recourse to such violent, extensive, and rapid geological changes as would seem to be necessary to produce alternate inundations and emergences of large areas of land.

As to the nature of the canals, it is still more difficult to suggest any satisfactory explanation. Several hypotheses have been presented, none of which appears entirely to meet the case. I have already remarked that there has not been lacking the suggestion that these curious streaks represent the lines of actual artificial water-courses on Mars. The straight and undeviating course which they pursue might be regarded as lending some degree of probability to such a view, but the enormous scale on which they exist seems to compel the rejection of the hypothesis. It is true that, if we consider only the influence of the force of gravity on Mars, giants could dwell upon that planet whose mechanical achievements might vastly surpass the greatest performances of our engineers; for a body weighing a ton on the earth would weigh only seven hundred and sixty pounds on Mars, and on the other hand a man on Mars possessing relatively the same activity as one of us might be fifteen feet tall and strong in propor-

tion. But even granting the existence of such a race of Goliaths on our neighbor world, it is not conceivable that they could have constructed a system of tremendous canals over half the surface of their planet, or that they would have done it if they could. The canals of Mars are enormously disproportioned in magnitude to the most gigantic inhabitants that a due regard for the law of gravitation would suffer us to imagine there.

An ingenious Frenchman has considerately and considerably diminished the difficulty for the inhabitants of Mars by the suggestion that the continents of that planet are so slightly elevated above the level of its seas that frequent and periodical inundations occur over large areas, thus forming temporary channels of communication between the seas which leave only the more elevated points above water to serve as places of refuge for the non-aquatic inhabitants. According to the theory, these inhabitants, possessing a horse sense comparable to that of the descendants of Noah, have, in the course of ages, improved and strengthened their natural places of refuge in times of flood, by excavating the ground from the low lands periodically invaded by the sea, and piling it up on the higher places, thus producing lines of partly artificial hills geometrically placed, and with talus-like flanks.

It will be observed that these attempts at explanation make no reference to the duplication of the canals. Mr. Proctor, always fertile in ingenious theories, undertook to include this strange transformation in an explanation of the canals which he suggested; namely, that they are great rivers, over and along which, in certain seasons, vast fog-banks are formed, or which, perhaps, being frozen in winter, remain covered with snow and ice in spring until the snow is melted along their banks, so that by a phenomenon of diffraction the image of the rivers appears to us as a light line between two dark ones.

M. Fizeau has put forth a theory according to which the canals of Mars are simply glacial productions, enormous crevasses and clefts in the ice covering the planet, like those seen on a smaller scale in our glaciers. But this theory, of course, would imply that Mars is now undergoing the effects of a glacial epoch, involving even the equatorial regions of the planet, while, as a matter of fact, the surface of Mars appears not to suffer from any extreme degree of cold. Attention has also been called to a fancied resemblance between the rectilineal canal system of Mars and the systems of rays seen on the moon, especially that which has its center at the crater Tycho, and which, under certain illuminations, is one of the most conspicuous features of the lunar surface.

In fact, it may be said, in a double sense, that there is no end of speculations on this curious subject. But nothing has yet been proposed that covers all the appearances presented, and even a

combination of atmospheric and geological activities seems insufficient to explain everything. It is possible that some deception of the eye may enter to a minor degree into the observations that have been so carefully described by Schiaparelli and others, but I can not believe that that excellent observer has been mistaken as to the main facts.

Mars is a world having an atmosphere as the Earth has, and possessing a diversified surface, upon which great operations of Nature are taking place under our eyes; and, while it may be idle for us to speculate as to whether those operations involve the weal or woe of a race of intelligent beings dwelling in the midst of them, yet the mind of man will never be satisfied to let such questions as these alone. If he can plant his foot upon one globe only, at least his thoughts can and will range among a million.

## BEGINNINGS IN SCIENCE AT MUGBY SCHOOL.*

By Dr. J. E. TAYLOR, F. R. S.

JACK HAMPSON was a capital sample of the best traditions of Mugby School. A lad of fourteen, with well-knit limbs, brave, honest-looking, bluish-gray eyes, a good cricketer and swimmer, and not bad at a high jump. He could no more do a mean thing than he could tell a lie; and he could give or take a thrashing if absolutely necessary, although he would be in no hurry for either.

Mugby School has kept the lead in modern educational progress which a former distinguished master introduced many years ago. That master was not content that boys should learn Latin and Greek. He was more anxious they should learn to be Christian gentlemen; to fear and eschew an untruth as they would poison; to be brave and yet gentle; tender toward the weak, not defiant even to the strong. The boys at Mugby School were well acquainted with the lives of the best men of all ages and of all nations, as well as with the most stirring deeds of valor, self-denial, and manly bravery. The noblest thoughts of the wisest men were drawn freely upon for their benefit.

Much of this "new education" was thought an innovation at first; but never before were English lads turned out of school in such high-toned, manly form, or so well able to hold their own at the universities, or in the bigger world outside.

As may be imagined, the wonders of science had not been ignored in such a school. One can hardly believe that modern science is almost included within the present century. All before

* From advance-sheets of "The Playtime Naturalist," in press of D. Appleton & Co.

then, except astronomy, was more or less speculation. Nobody would call Linnæus's system of botany a science, although it was very useful and introductory; nor was geology, zoölogy, nor chemistry. Scientists had only been playing, like children, in the vestibule of the great temple. It may be that we ourselves have not advanced far within the precincts—at least those who study these subjects a hundred years hence may think so. But, at any rate, the amount of knowledge extant concerning the world in which we live, and its ancient and modern inhabitants, is vast compared with what it was when the present century commenced.

At Mugby School, science was an important and also a welcome subject. How welcome it was is best indicated by the fact that the boys got up a Natural History Society among themselves. This was really a self-imposed task, done out of school-hours. Some of the principal teachers encouraged the lads by becoming members; not that they knew much of natural history or scientific subjects (some of them, indeed, knew nothing at all, and actually learned a good deal from the boys themselves).

Of course, the society was founded on the best models. It was not a bit behind the famous "Royal Society of London" in its equipment. It had its president and vice-president, and its committee were called "the council." It also published, for the world's benefit, abstracts of the short papers the boys read—the abstracts being nearly as long as the papers. Although its members were not numerous, they felt they bore the weight of the dignity of the society on their shoulders; and, as they were too boyish-manly to be priggish, the training did them no harm.

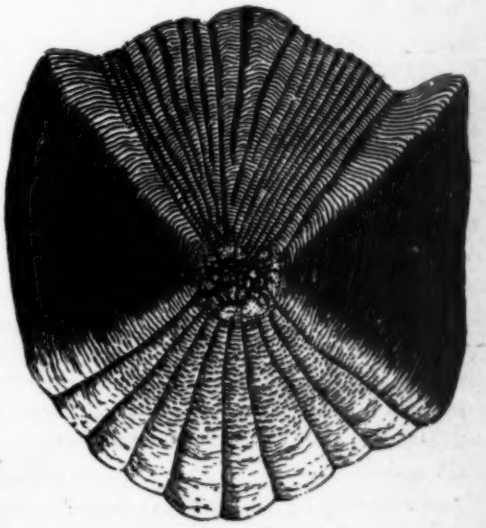


Fig. 1.—Scale of Chub.

Well, the society was divided into sections. One section was appointed to collect the plants of the neighborhood—that is, those obtainable during the school half-holidays; another to collect butterflies and moths; a third, beetles; a fourth, birds; a fifth, fossils, etc. They were to publish lists of the plants, birds, insects, and fossils of the district in the "Society's Proceedings"; for, of course, the latter was the name given to the abstracted papers.

The society had only been founded the year before Jack Hampson was sent to Mugby School; so it was in the first zeal and freshness of its youth. Jack didn't like science—it was nothing but a lot of hard, jaw-breaking names, he said, and what was the good of them? He and others had enough of hard words in their daily Latin and Greek tasks. Jack rather snubbed the fellows who volunteered to learn more hard words than were required—he couldn't understand it. What was the good of calling a buttercup *Ranunculus*, and a white stone *quartz?* It was all sham and show!

Now, Jack was a born hunter. He was ardently fond of fishing, and not a bad shot, considering he had been mistrusted, instead of trusted, with a gun. I dare say his skill with the latter would have astonished his father; and I have no doubt a good many ounces of 'bacca found their way into the keeper's pocket before he became so creditable a shot.

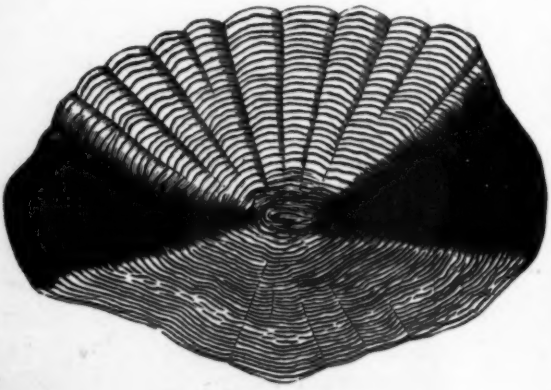


FIG. 2.—SCALE OF BLEAK.

But there was not much fishing about Mugby; or, rather, they were such little things that Jack felt ashamed of pulling them out, and so he slipped them in again, although they never seemed to grow any bigger. This was a wise act on their part, if they had only known the unconscious chivalry of Jack's nature, which hated

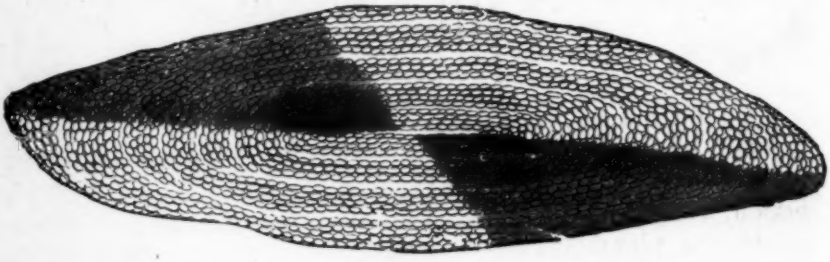


FIG. 3.—SCALE OF EEL.

taking advantage of a weak thing. Then as to shooting—first, he hadn't a gun, and, if he had possessed one, the rules of the school would have precluded his using it. Next, what was there to shoot? The small birds in the hedges? Any cad could do that! Sneak

after the poor beggars behind hedges, and then bang at a robin, a wren, a yellow-hammer, or a tit, and perhaps blow it to pieces! That was not good enough. Partridge and pheasant shooting, Jack thought, are hardly much better sport, only you can eat them.

Of course, there was the excitement of cricket and foot-ball, hare-and-hounds, paper-chases, hurdle-racing, jumping—not only not bad, but altogether good and brave and manly sports. But, somehow, a lad of superior mental abilities wants something else.

Now, the scientist is also a hunter. He traces his descent from Nimrod—he is a hunter before the Lord. He roams through the stellar universe for his prey—hunts for stars, comets, planets. He is not daunted because he did not live on the world when it was young, millions of years ago; for he makes up for it by hunting the remains of the animals and plants that lived during countless

FIG. 4.—SCALE OF ROACH.

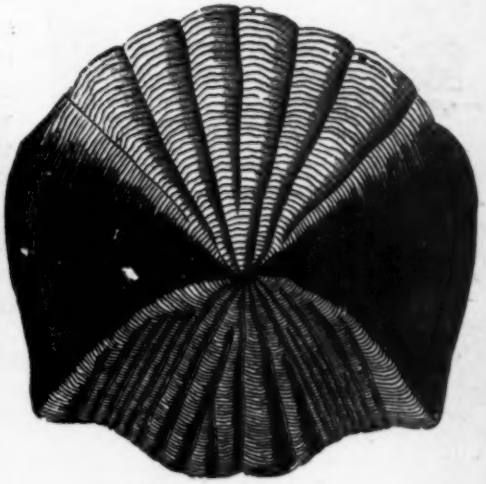


FIG. 5.—SCALE OF DACE.

ages, and which have long been buried in the rocks of the earth's crust as *fossils*. He hunts for flowering plants and animals in all parts of the earth; braves heat and cold, hunger and thirst, wounds and death, in his ardent search for them. The structures of rocks do not escape his mineralogical hunting, nor the composition of any sort of substance, organic or inorganic, his chemical analysis. He hunts down stars thousands of millions of miles away with his telescope, and creatures less than the fifteen-thousandth part of an inch long with his microscope. Was there ever such a great hunter? This hunting instinct began scores of thousands of years ago, when the hairy, naked Palæolithic men hunted extinct hairy elephants and rhinoceroses. It has been de-

veloped until it has assumed the high intellectual pleasure of roaming through God's great creation, and of confirming the ancient writer's conclusion—"Lo, there is no end to it!"

Of all these things Jack Hampson had never heard a word. Perhaps he had occasionally listened to a few joking remarks about Darwin and our "being descended from monkeys" at his father's dinner-table. But his father (who was anything but a wealthy man these hard agricultural times, although he farmed his own estate) had not much time for considering the discoveries of modern science. Their echoes faintly reached him occasionally, but never touched him seriously. Not only were the times bad, but his family was large, and it was not without a stretch that Jack was sent to Mugby School, rather more than twenty miles off. His brother (Jack's uncle) was better off, because he had no family; and the uncle also had more leisure, and, what is more, was really a man of a literary and scientific turn of mind.

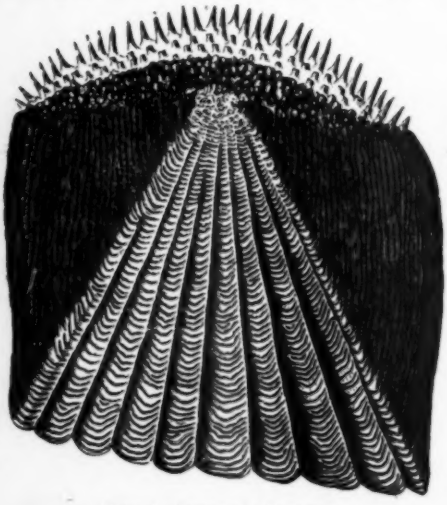


FIG. 6.—SCALE OF GUDGEON.

All school-boys make friends at school. Nobody has ever analyzed the process of friend-making among boys. It is as mysterious as genuine love-making. Friendships—at least, boys' friendships—are also made "at first sight." Live in a public school a few years, and you will find it out. You might just as well tell a boy to make friends with a certain other boy, as order him to make love a few years later with your female selection! And yet what issues of life depend on those boyish friendships made at school! They are often more durable than marriages. They survive success, disaster, and disease. Not unfrequently, they are prolonged to the second and third generation. If there

FIG. 7.—SCALE OF BREAM.

is one thing more difficult to explain concerning instincts than another, it is the instinct of boys' friendships.

How Jack Hampson—big-limbed, broad-backed Jack—came to take up, the very day he arrived at Mugby, with little Willie Ransome, I can not tell. There is something in the doctrine of contrasts; doubtless Willie was as great a contrast to Jack as you would have found in the whole school—rather undersized, weakly, but nevertheless a brave and truthful boy. He was fond of books—a trifle too fond, for it would have done him good to have got away from them a little. The chief feature about Willie was his large, bright, inquiring eyes, and his altogether affectionate disposition. He took to Jack at once, and Jack to him. Never before was there a better illustration of "friendship at first sight."

FIG. 8.—SCALE OF LOACH.

It was at the commencement of the spring term that the friends came to Mugby School. Without knowing it, but fortunately for them and for the whole school, a fine, enthusiastic young fellow had been appointed "science teacher." The term sounds vague, but so do all terms if too strictly analyzed. The boys dubbed him "professor," and thereby unconsciously gave him higher rank than his *confrères*, who were only "teachers." It would have been impossible for a young man to have been selected better fitted for such a post. Nothing gets hold of boys sooner than enthusiasm. Boys are naturally enthusiastic. There is no better proof of vitality, even in an old man, than that he continues to be enthusiastic about anything intellectual.

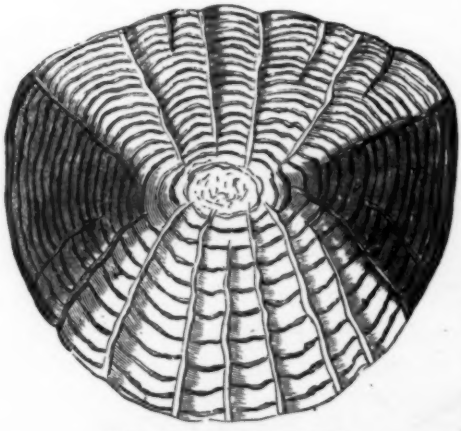


FIG. 9.—SCALE OF MINNOW.

Willie Ransome's father was a village doctor, and it was hoped Willie would some day help his father in his increasingly larger, but not increasingly profitable, rounds. Willie entered the science class the first term. His father was a man of scientific tastes, with

little leisure to indulge them. But he had already inoculated his only son with a love for such subjects. Willie, however, had never before been drawn within the magic circle of enthusiasm for them, and his highly sensitive temperament was fixed by the professor's descriptions and demonstrations immediately. Before the term was half over, he was a member of the society, and doing his best to "collect" for the society's museum.

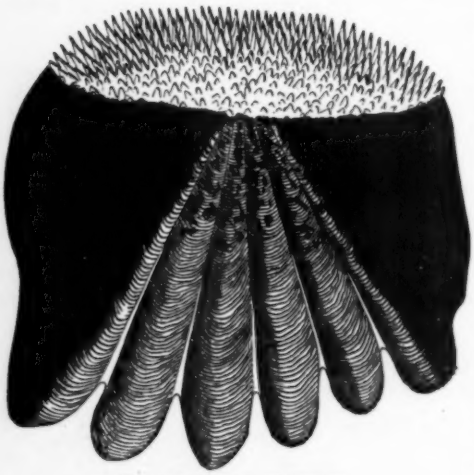


FIG. 10.—SCALE OF PERCH.

Jack had many a hearty laugh over this disposition to hoard up a lot of old stones and things, and give them hard names. More than once he was asked to attend a society's meeting —for each member had the privilege of introducing a friend—but he always shirked it. "No," he said; "they are not my sort."

One wet evening, however, Willie Ransome got Jack to go, just because there was nothing else to do. There was a short paper being read on "Fish-Scales," and a number of them were mounted for microscopical examination, of course with a low power, say inch and half-inch. Anything relating to fish or fishing was certain to gain Jack's attention, therefore a better subject could not have been selected to engage his notice. Besides, Jack had never yet even looked through a microscope! He felt a bit ashamed of this now; but there were a couple of microscopes present, and Jack determined to have a good look through them. The scales of different sorts of British fishes were on view. Of course, fish-scales are common enough; but who would think that each kind

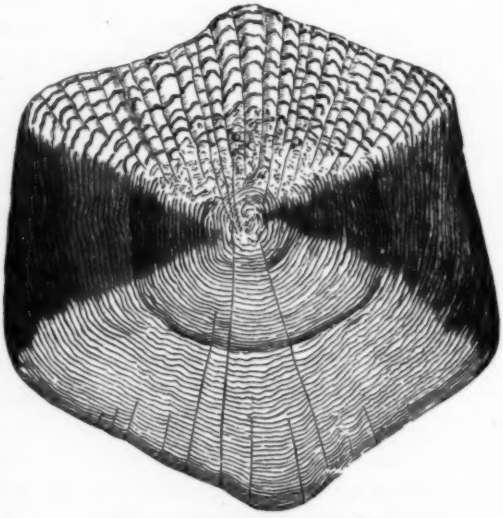


FIG. 11.—SCALE OF COMMON CARP.

has its own pattern of scale, and that you could tell a species of fish by its scales?

The paper showed that the scales of fishes were composed of the same material, *chitine*, as the feathers of birds, or the hair and nails of animals—a kind of substance only found in the animal kingdom, and never in the vegetable; that these scales are developed in little pockets in the fish's skin, which you can plainly see for yourself when a herring is scaled. They are arranged all over the fish's body like the tiles covering a roof, partly overlapping each other, as is seen by one part of the scale being often different from the other.

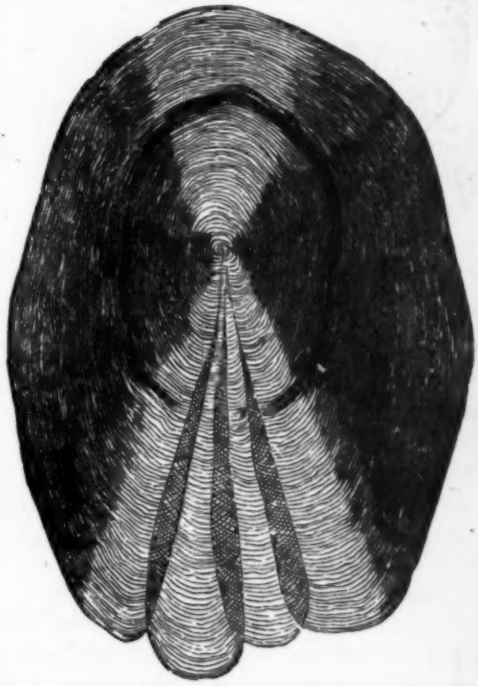


FIG. 12.—SCALE OF PIKE.

Jack looked through the microscope and was delighted. He was always a reverent-minded boy, and the sight broke on his mind like a new revelation. How exquisitely chaste and beautiful were the markings, lines, dots, and other peculiarities! Then the scales which run along the middle line of the fish were shown him, and the ducts perforating them, out of which the mucus flows to anoint the fish's body, and thus reduce the friction of its rapid movement through the water. The lad was half bewildered at the possibility of the new knowledge. "Could anybody get to know about these things?" he asked Willie, who told him of course he could, if he would only take a little trouble.

"But," said his young friend, "I would advise you to get a pocket-magnifier first, and begin to examine with that. Some fellows begin right off with a powerful microscope they get their governors to buy them, and they work it like mad for a month or two, and then get tired of it. Fact is, they never learned the art of observing."

"What do you mean by that?" said Jack.

"Why, getting into the habit of looking about you, keeping your eyes open, and quickly spotting anything unusual. Fancy a fellow beginning to use magnifying glasses of thousands of times

before he has begun to use his own eyes! Use your own eyes first, then get a little extra help in the shape of a shilling pocket-lens, and by and by you will be able to use a real microscope, and enjoy using it too."

This was rather a long lecture for Willie to give, or for Jack to listen to. He wouldn't have listened if it had not been for what he had just seen. He said nothing, but he made up his mind he would get one of these useful shilling magnifiers. Willie usually had a country walk during the school half-holiday, and Jack had often been invited to accompany him; but he didn't care to go "humbugging after grubs and weeds," he said. Now, however, he invited himself, and somewhat surprised his friend by stating he wanted to go with him.

FIG. 13.—SCALE OF GRAYLING.

## AGNOSTICISM.

### A REPLY TO PROFESSOR HUXLEY.

I.

BY REV. DR. HENRY WACE, PRINCIPAL OF KING'S COLLEGE.

IT would hardly be reasonable to complain of Prof. Huxley's delay in replying to the paper on "Agnosticism" which I read five months ago, when, at the urgent request of an old friend, I reluctantly consented to address the Church Congress at Manchester. I am obliged to him for doing it the honor to bring it to the notice of a wider circle than that to which it was directly addressed; and I fear that, for reasons which have been the occasion of universal regret, he may not have been equal to literary effort. But, at the same time, it is impossible not to notice that a writer is at a great advantage in attacking a fugitive essay a quarter of a year after it was made public. Such a lapse of time ought, indeed, to enable him to apprehend distinctly the argument with which he is dealing; and it might, at least, secure him from any such inaccuracy in quotation as greater haste might excuse. But if either his idiosyncrasy, or his sense of assured superiority, should

lead him to pay no real attention to the argument he is attacking, or should betray him into material misquotation, he may at least be sure that scarcely any of his readers will care to refer to the original paper, or will have the opportunity of doing so. I can scarcely hope that Prof. Huxley's obliging reference to the "Official Report of the Church Congress" will induce many of those who are influenced by his answer to my paper to purchase that interesting volume, though they would be well repaid by some of its other contents; and I can hardly rely on their spending even twopence upon the reprint of the paper, published by the Society for Promoting Christian Knowledge. I have therefore felt obliged to ask the editor of this review to be kind enough to admit to his pages a brief restatement of the position which Prof. Huxley has assailed, with such notice of his arguments as is practicable within the comparatively brief space which can be afforded me. I could not, indeed, amid the pressing claims of a college like this in term time, besides the chairmanship of a hospital, a preachership, and other duties, attempt any reply which would deal as thoroughly as could be wished with an article of so much skill and finish. But it is a matter of justice to my cause and to myself to remove at once the unscientific and prejudiced representation of the case which Prof. Huxley has put forward; and fortunately there will be need of no elaborate argument for this purpose. There is no occasion to go beyond Prof. Huxley's own article and the language of my paper to exhibit his entire misapprehension of the point in dispute; while I am much more than content to rely for the invalidation of his own contentions upon the authorities he himself quotes.

What, then, is the position with which Prof. Huxley finds fault? He is good enough to say that what he calls my "description" of an agnostic may for the present pass, so that we are so far, at starting, on common ground. The actual description of an agnostic, which is given in my paper, is indeed distinct from the words he quotes, and is taken from an authoritative source. But what I have said is that, as an escape from such an article of Christian belief as that we have a Father in heaven, or that Jesus Christ is the Judge of quick and dead, and will hereafter return to judge the world, an agnostic urges that "he has no means of a scientific knowledge of the unseen world or of the future"; and I maintain that this plea is irrelevant. Christians do not presume to say that they have a scientific knowledge of such articles of their creed. They say that they believe them, and they believe them mainly on the assurances of Jesus Christ. Consequently their characteristic difference from an agnostic consists in the fact that they believe those assurances, and that he does not. Prof. Huxley's observation, "Are there then any Christians who say that they

know nothing about the unseen world and the future? I was ignorant of the fact, but I am ready to accept it on the authority of a professed theologian," is either a quibble, or one of many indications that he does not recognize the point at issue. I am speaking, as the sentence shows, of scientific knowledge—knowledge which can be obtained by our own reason and observation alone—and no one with Prof. Huxley's learning is justified in being ignorant that it is not upon such knowledge, but upon supernatural revelation, that Christian belief rests. However, as he goes on to say, my view of "the real state of the case is that the agnostic 'does not believe the authority' on which 'these things' are stated, which authority is Jesus Christ. He is simply an old-fashioned 'infidel' who is afraid to own to his right name." The argument has nothing to do with his motive, whether it is being afraid or not. It only concerns the fact that that by which he is distinctively separated from the Christian is that he does not believe the assurances of Jesus Christ.

Prof. Huxley thinks there is "an attractive simplicity about this solution of the problem"—he means, of course, this statement of the case—"and it has that advantage of being somewhat offensive to the persons attacked, which is so dear to the less refined sort of controversialist." I think Prof. Huxley must have forgotten himself and his own feelings in this observation. There can be no question, of course, of his belonging himself to the more refined sort of controversialists; but he has a characteristic fancy for solutions of problems, or statements of cases, which have the "advantage of being somewhat offensive to the persons attacked." Without taking this particular phrase into account, it certainly has "the advantage of being offensive to the persons attacked" that Prof. Huxley should speak in this article of "the pestilent doctrine on which all the churches have insisted, that honest disbelief"—the word "honest" is not a misquotation—"honest disbelief in their more or less astonishing creeds is a moral offense, indeed a sin of the deepest dye, deserving and involving the same future retribution as murder or robbery," or that he should say, "Trip in morals or in doctrine (especially in doctrine), without due repentance or retractation, or fail to get properly baptized before you die, and a *plébiscite* of the Christians of Europe, if they were true to their creeds, would affirm your everlasting damnation by an immense majority." We have fortunately nothing to do in this argument with *plébiscites;* and as statements of authoritative Christian teaching, the least that can be said of these allegations is that they are offensive exaggerations. It had "the advantage" again, of being "offensive to the persons attacked," when Prof. Huxley, in an article in this review on "Science and the Bishops," in November, 1887, said that "scientific ethics can and does declare

that the profession of belief" in such narratives as that of the devils entering a herd of swine, or of the fig-tree that was blasted for bearing no figs, upon the evidence on which multitudes of Christians believe it, "is immoral"; and the observation which followed, that "theological apologists would do well to consider the fact that, in the matter of intellectual veracity, Science is already a long way ahead of the churches," has the same "advantage." I repeat that I can not but treat Prof. Huxley as an example of the more refined sort of controversialist; it must be supposed, therefore, that when he speaks of observations or insinuations which are somewhat offensive to the "persons attacked" being dear to the other sort of controversialists, he is unconscious of his own methods of controversy—or, shall I say, his own temptations?

But I desire as far as possible to avoid any rivalry with Prof. Huxley in these refinements—more or less—of controversy; and am, in fact, forced by pressure both of space and of time to keep as rigidly as possible to the points directly at issue. He proceeds to restate the case as follows: "The agnostic says, 'I can not find good evidence that so and so is true.' 'Ah,' says his adversary, seizing his opportunity, 'then you declare that Jesus Christ was untruthful, for he said so and so'—a very telling method of rousing prejudice." Now that superior scientific veracity to which, as we have seen, Prof. Huxley lays claim, should have prevented him putting such vulgar words into my mouth. There is not a word in my paper to charge agnostics with declaring that Jesus Christ was "untruthful." I believe it impossible in these days for any man who claims attention—I might say, for any man—to declare our Lord untruthful. What I said, and what I repeat, is that the position of an agnostic involves the conclusion that Jesus Christ was under an "illusion" in respect to the deepest beliefs of his life and teaching. The words of my paper are, "An agnosticism which knows nothing of the relation of man to God must not only refuse belief to our Lord's most undoubted teaching, but must deny the reality of the spiritual convictions in which he lived and died." The point is this—that there can, at least, be no reasonable doubt that Jesus Christ lived, and taught, and died, in the belief of certain great principles respecting the existence of God, our relation to God, and his own relation to us, which an agnostic says are beyond the possibilities of human knowledge; and of course an agnostic regards Jesus Christ as a man. If so, he must necessarily regard Jesus Christ as mistaken, since the notion of his being untruthful is a supposition which I could not conceive being suggested. The question I have put is not, as Prof. Huxley represents, what is the most unpleasant alternative to belief in the primary truths of the Christian religion, but what is the least un-

pleasant; and all I have maintained is that the least unpleasant alternative necessarily involved is, that Jesus Christ was under an illusion in his most vital convictions.

I content myself with thus rectifying the state of the case, without making the comments which I think would be justified on such a crude misrepresentation of my argument. But Prof. Huxley goes on to observe that "the value of the evidence as to what Jesus may have said and done, and as to the exact nature and scope of his authority, is just that which the agnostic finds it most difficult to determine." Undoubtedly, that is a primary question; but who would suppose from Prof. Huxley's statement of the case that the argument of the paper he is attacking proceeded to deal with this very point, and that he has totally ignored the chief consideration it alleged? Almost immediately after the words Prof. Huxley has quoted, the following passage occurs, which I must needs transfer to these pages, as containing the central point of the argument: "It may be asked how far we can rely on the accounts we possess of our Lord's teaching on these subjects. Now it is unnecessary for the general argument before us to enter on those questions respecting the authenticity of the gospel narratives, which ought to be regarded as settled by M. Renan's practical surrender of the adverse case. *Apart from all disputed points of criticism, no one practically doubts that our Lord lived, and that he died on the cross, in the most intense sense of filial relation to his Father in heaven, and that he bore testimony to that Father's providence, love, and grace toward mankind. The Lord's Prayer affords sufficient evidence upon these points. If the Sermon on the Mount alone be added, the whole unseen world, of which the agnostic refuses to know anything, stands unveiled before us. There you see revealed the divine Father and Creator of all things, in personal relation to his creatures, hearing their prayers, witnessing their actions, caring for them and rewarding them. There you hear of a future judgment administered by Christ himself, and of a heaven to be hereafter revealed, in which those who live as the children of that Father, and who suffer in the cause and for the sake of Christ himself, will be abundantly rewarded. If Jesus Christ preached that sermon, made those promises, and taught that prayer, then any one who says that we know nothing of God, or of a future life, or of an unseen world, says that he does not believe Jesus Christ.*"

Prof. Huxley has not one word to say upon this argument, though the whole case is involved in it. Let us take as an example the illustration he proceeds to give. "If," he says, "I venture to doubt that the Duke of Wellington gave the command, 'Up, Guards, and at 'em!' at Waterloo, I do not think that even Dr. Wace would accuse me of disbelieving the duke." Certainly

not. But if Prof. Huxley were to maintain that the pursuit of glory was the true motive of the soldier, and that it was an illusion to suppose that simple devotion to duty could be the supreme guide of military life, I should certainly charge him with contradicting the duke's teaching and disregarding his authority and example. A hundred stories like that of "Up, Guards, and at 'em!" might be doubted, or positively disproved, and it would still remain a fact beyond all reasonable doubt that the Duke of Wellington was essentially characterized by the sternest and most devoted sense of duty, and that he had inculcated duty as the very watchword of a soldier; and even Prof. Huxley would not suggest that Lord Tennyson's ode, which has embodied this characteristic in immortal verse, was an unfounded poetical romance.

The main question at issue, in a word, is one which Prof. Huxley has chosen to leave entirely on one side—whether, namely, allowing for the utmost uncertainty on other points of the criticism to which he appeals, there is any reasonable doubt that the Lord's Prayer and the Sermon on the Mount afford a true account of our Lord's essential belief and cardinal teaching. If they do—then I am not now contending that they involve the whole of the Christian creed; I am not arguing, as Prof. Huxley would represent, that he ought for that reason alone to be a Christian—I simply represent that, as an agnostic, he must regard those beliefs and that teaching as mistaken—the result of an illusion, to say the least. I am not going, therefore, to follow Prof. Huxley's example, and go down a steep place with the Gadarene swine into a sea of uncertainties and possibilities, and stake the whole case of Christian belief as against agnosticism upon one of the most difficult and mysterious narratives in the New Testament. I will state my position on that question presently. But I am first and chiefly concerned to point out that Prof. Huxley has skillfully evaded the very point and edge of the argument he had to meet. Let him raise what difficulties he pleases, with the help of his favorite critics, about the Gadarene swine, or even about all the stories of demoniacs. He will find that his critics—and even critics more rationalistic than they—fail him when it comes to the Lord's Prayer and the Sermon on the Mount, and, I will add, the story of the Passion. He will find, or rather he must have found, that the very critics he relies upon recognize that in the Sermon on the Mount and the Lord's Prayer, allowing for variations in form and order, the substance of our Lord's essential teaching is preserved. On a point which, until Prof. Huxley shows cause to the contrary, can hardly want argument, the judgment of the most recent of his witnesses may suffice—Prof. Reuss, of Strasburg. In Prof. Huxley's article on the "Evolution of Theology" in the number of this review for March, 1886,

he says, "As Reuss appears to me to be one of the most learned, acute, and fair-minded of those whose works I have studied, I have made most use of the commentary and dissertations in his splendid French edition of the Bible." What, then, is the opinion of the critic for whom Prof. Huxley has this regard? In the volume of his work which treats of the first three Gospels, Reuss says at page 191–192, "If anywhere the tradition which has preserved to us the reminiscences of the life of Jesus upon earth carries with it certainty and the evidence of its fidelity, it is here"; and again: "In short, it must be acknowledged that the redactor, in thus concentrating the substance of the moral teaching of the Lord, has rendered a real service to the religious study of this portion of the tradition, and the reserves which historical criticism has a right to make with respect to the form will in no way diminish this advantage." It will be observed that Prof. Reuss thinks, as many good critics have thought, that the Sermon on the Mount combines various distinct utterances of our Lord, but he none the less recognizes that it embodies an unquestionable account of the substance of our Lord's teaching.

But it is surely superfluous to argue either this particular point, or the main conclusion which I have founded on it. Can there be any doubt whatever, in the mind of any reasonable man, that Jesus Christ had beliefs respecting God which an agnostic alleges there is no sufficient ground for? We know something at all events of what his disciples taught; we have authentic original documents, unquestioned by any of Prof. Huxley's authorities, as to what St. Paul taught and believed, and of what he taught and believed respecting his Master's teaching; and the central point of this teaching is a direct assertion of knowledge and revelation as against the very agnosticism from which Prof. Huxley manufactured that designation. "As I passed by," said St. Paul at Athens, "I found an altar with this inscription: 'To the unknown God.' Whom therefore ye ignorantly—or in agnosticism—worship, Him I declare unto you." An agnostic withholds his assent from this primary article of the Christian creed; and though Prof. Huxley, in spite of the lack of information he alleges respecting early Christian teaching, knows enough on the subject to have a firm belief "that the Nazarenes, say of the year 40," headed by James, would have stoned any one who propounded the Nicene Creed to them, he will hardly contend that they denied that article, or doubted that Jesus Christ believed it. Let us again listen to the authority to whom Prof. Huxley himself refers. Reuss says at page 4 of the work already quoted:

> Historical literature in the primitive church attaches itself in the most immediate manner to the reminiscences collected by the apostles and their friends,

directly after their separation from their Master. The need of such a return to the past arose naturally from the profound impression which had been made upon them by the teaching, and still more by the individuality itself of Jesus, and on which both their hopes for the future and their convictions were founded. . . . It is in these facts, in this continuity of a tradition which could not but go back to the very morrow of the tragic scene of Golgotha that we have a strong guarantee for its authenticity. . . . We have direct historical proof that the thread of tradition was not interrupted. Not only does one of our evangelists furnish this proof in formal terms (Luke i, 2); but in many other places besides we perceive the idea, or the point of view, that all which the apostles know, think, and teach, is at bottom and essentially a reminiscence—a reflection of what they have seen and learned at another time, a reproduction of lessons and impressions received.

Now let it be allowed for argument's sake that the belief and teaching of the apostles are distinct from those of subsequent Christianity, yet it is surely a mere paradox to maintain that they did not assert, as taught by their Master, truths which an agnostic denies. They certainly spoke, as Paul did, of the love of God; they certainly spoke, as Paul did, of Jesus having been raised from the dead by God the Father (Gal. i, 1); they certainly spoke, as Paul did, of Jesus Christ returning to judge the world; they certainly spoke, as Paul did, of "the God and Father of our Lord Jesus Christ" (2 Cor. xi, 31). That they could have done this without Jesus Christ having taught God's love, or having said that God was his Father, or having declared that he would judge the world, is a supposition which will certainly be regarded by an overwhelming majority of reasonable men as a mere paradox; and I can not conceive, until he says so, that Prof. Huxley would maintain it. But if so, then all Prof. Huxley's argumentation about the Gadarene swine is mere irrelevance to the argument he undertakes to answer. The Gospels might be obliterated as evidence to-morrow, and it would remain indisputable that Jesus Christ taught certain truths respecting God, and man's relation to God, from which an agnostic withholds his assent. If so, he does not believe Jesus Christ's teaching; he is so far an unbeliever, and "unbeliever," Dr. Johnson says, is an equivalent of "infidel."

This consideration will indicate another irrelevance in Prof. Huxley's argument. He asks for a definition of what a Christian is, before he will allow that he can be justly called an infidel. But without being able to give an accurate definition of a crayfish, which perhaps only Prof. Huxley could do, I may be very well able to say that some creatures are not crayfish; and it is not necessary to frame a definition of a Christian in order to say confidently that a person who does not believe the broad and unquestionable elements of Christ's teachings and convictions is not a Christian. "Infidel" or "unbeliever" is of course, as Prof. Huxley

says, a relative and not a positive term. He makes a great deal of play out of what he seems to suppose will be a very painful and surprising consideration to myself, that to a Mohammedan I am an infidel. Of course I am; and I should never expect a Mohammedan, if he were called upon, as I was, to argue before an assembly of his own fellow-believers, to call me anything else. Prof. Huxley is good enough to imagine me in his company on a visit to the Hazar Mosque at Cairo. When he entered that mosque without due credentials, he suspects that, had he understood Arabic, "dog of an infidel" would have been by no means the most "unpleasant" of the epithets showered upon him, before he could explain and apologize for the mistake. If, he says, "I had had the pleasure of Dr. Wace's company on that occasion, the undiscriminative followers of the Prophet would, I am afraid, have made no difference between us; not even if they had known that he was the head of an orthodox Christian seminary." Probably not; and I will add that I should have felt very little confidence in any attempts which Prof. Huxley might have made, in the style of his present article, to protect me, by repudiating for himself the unpleasant epithets which he deprecates. It would, I suspect, have been of very little avail to attempt a subtle explanation, to one of the learned mollahs of whom he speaks, that he really did not mean to deny that there was one God, but only that he did not know anything on the subject, and that he desired to avoid expressing any opinion respecting the claims of Mohammed. It would be plain to the learned mollah that Prof. Huxley did not believe either of the articles of the Mohammedan creed—in other words that, for all his fine distinctions, he was at bottom a downright infidel, such as I confessed myself, and that there was an end of the matter. There is no fair way of avoiding the plain matter of fact in either case. A Mohammedan believes and asserts that there is no God but God, and that Mohammed is the prophet of God. I don't believe Mohammed. In the plain, blunt, sensible phrase people used to use on such subjects I believe he was a false prophet, and I am a downright infidel about him. The Christian creed might almost be summed up in the assertion that there is one, and but one God, and that Jesus Christ is his prophet; and whoever denies that creed says that he does not believe Jesus Christ, by whom it was undoubtedly asserted. It is better to look facts in the face, especially from a scientific point of view. Whether Prof. Huxley is justified in his denial of that creed is a further question, which demands separate consideration, but which was not, and is not now, at issue. All I say is that his position involves that disbelief or infidelity, and that this is a responsibility which must be faced by agnosticism.

But I am forced to conclude that Prof. Huxley can not have taken the pains to understand the point I raised, not only by the irrelevance of his argument on these considerations, but by a misquotation which the superior accuracy of a man of science ought to have rendered impossible. Twice over in the article he quotes me as saying that "it is, and it ought to be, an unpleasant thing for a man to have to say plainly that he does not believe in Jesus Christ." As he winds up his attack upon my paper by bringing against this statement his rather favorite charge of "immorality" —and even "most profound immorality"—he was the more bound to accuracy in his quotation of my words. But neither in the official report of the congress to which he refers, nor in any report that I have seen, is this the statement attributed to me. What I said, and what I meant to say, was that it ought to be an unpleasant thing for a man to have to say plainly "that he does not believe Jesus Christ." By inserting the little word "in," Prof. Huxley has, by an unconscious ingenuity, shifted the import of the statement. He goes on to denounce "the pestilent doctrine on which all the churches have insisted, that honest disbelief in their more or less astonishing creeds is a moral offense, indeed a sin of the deepest dye."* His interpretation exhibits, in fact, the idea in his own mind, which he has doubtless conveyed to his readers, that I said it ought to be unpleasant to a man to have to say that he does not believe in the Christian creed. I certainly think it ought, for reasons I will mention; but that is not what I said. I spoke, deliberately, not of the Christian creed as a whole, but of Jesus Christ as a person, and regarded as a witness to certain primary truths which an agnostic will not acknowledge. It was a personal consideration to which I appealed, and not a dogmatic one; and I am sorry, for that reason, that Prof. Huxley will not allow me to leave it in the reserve with which I hoped it had been sufficiently indicated. I said that "no criticism worth mentioning doubts the story of the Passion; and that story involves the most solemn attestation, again and again, of truths of which an agnostic coolly says he knows nothing. An agnosticism which knows nothing of the relation of man to God must not only refuse belief to our Lord's most undoubted teaching, but must deny the reality of the spiritual convictions in which he lived and died. It must declare that his most intimate, most intense beliefs, and his dying aspirations were an illusion. Is that supposition tolerable?" I do not think this deserves to be called "a proposition of the most profoundly immoral character." I think it ought to be unpleasant, and I am sure it always will be unpleasant, for a man to listen to the Saviour on the cross uttering such words as "Father, into thy hands I commend my spirit," and to

* "Popular Science Monthly" for April, 1889, p. 766.

say that they are not to be trusted as revealing a real relation between the Saviour and God. In spite of all doubts as to the accuracy of the Gospels, Jesus Christ—I trust I may be forgiven, under the stress of controversy, for mentioning his sacred name in this too familiar manner—is a tender and sacred figure to all thoughtful minds, and it is, it ought to be, and it always will be, a very painful thing, to say that he lived and died under a mistake in respect to the words which were first and last on his lips. I think, as I have admitted, that it should be unpleasant for a man who has as much appreciation of Christianity, and of its work in the world, as Prof. Huxley sometimes shows, to have to say that its belief was founded on no objective reality. The unpleasantness, however, of denying one system of thought may be balanced by the pleasantness, as Prof. Huxley suggests, of asserting another and a better one. But nothing, to all time, can do away with the unpleasantness, not only of repudiating sympathy with the most sacred figure of humanity in his deepest beliefs and feelings, but of pronouncing him under an illusion in his last agony. If it be the truth, let it by all means be said; but if we are to talk of "immorality" in such matters, I think there must be a lack of moral sensibility in any man who could say it without pain.

The plain fact is that this misquotation would have been as impossible as a good deal else of Prof. Huxley's argument, had he, in any degree, appreciated the real strength of the hold which Christianity has over men's hearts and minds. The strength of the Christian Church, in spite of its faults, errors, and omissions, is not in its creed, but in its Lord and Master. In spite of all the critics, the Gospels have conveyed to the minds of millions of men a living image of Christ. They see him there; they hear his voice; they listen, and they believe him. It is not so much that they accept certain doctrines as taught by him, as that they accept him, himself, as their Lord and their God. The sacred fire of trust in him descended upon the apostles, and has from them been handed on from generation to generation. It is with that living personal figure that agnosticism has to deal; and as long as the Gospels practically produce the effect of making that figure a reality to human hearts, so long will the Christian faith, and the Christian Church, in their main characteristics, be vital and permanent forces in the world. Prof. Huxley tells us, in a melancholy passage, that he can not define "the grand figure of Jesus." Who shall dare to "define" it? But saints have both written and lived an *imitatio Christi*, and men and women can feel and know what they can not define. Prof. Huxley, it would seem, would have us all wait coolly until we have solved all critical difficulties, before acting on such a belief. "Because," he says, "we are often obliged, by the pressure of events, to act on very

bad evidence, it does not follow that it is proper to act on such evidence when the pressure is absent." Certainly not; but it is strange ignorance of human nature for Prof. Huxley to imagine that there is no "pressure" in this matter. It was a voice which understood the human heart better which said, "Come unto me, all ye that labor and are heavy laden, and I will give you rest"; and the attraction of that voice outweighs many a critical difficulty under the pressure of the burdens and the sins of life.

Prof. Huxley, indeed, admits, in one sentence of his article, the force of this influence on individuals.

> If (he says) a man can find a friend, the hypostasis of all his hopes, the mirror of his ethical ideal, in the pages of any, or of all, of the Gospels, let him live by faith in that ideal. Who shall, or can, forbid him? But let him not delude himself with the notion that his faith is evidence of the objective reality of that in which he trusts. Such evidence is to be obtained only by the use of the methods of science, as applied to history and to literature, and it amounts at present to very little.

Well, a single man's belief in an ideal may be very little evidence of its objective reality. But the conviction of millions of men, generation after generation, of the veracity of the four evangelical witnesses, and of the human and divine reality of the figure they describe, has at least something of the weight of the verdict of a jury. *Securus judicat orbis terrarum.* Practically the figure of Christ lives. The Gospels have created it; and it subsists as a personal fact in life, alike among believers and unbelievers. Prof. Huxley himself, in spite of all his skepticism, appears to have his own type of this character. The apologue of the woman taken in adultery might, he says, "if internal evidence were an infallible guide, well be affirmed to be a typical example of the teachings of Jesus." Internal evidence may not be an infallible guide; but it certainly carries great weight, and no one has relied more upon it in these questions than the critics whom Prof. Huxley quotes.

But as I should be sorry to imitate Prof. Huxley, on so momentous a subject, by evading the arguments and facts he alleges, I will consider the question of external evidence on which he dwells. I must repeat that the argument of my paper is independent of this controversy. The fact that our Lord taught and believed what agnostics ignore is not dependent on the criticism of the four Gospels. In addition to the general evidence to which I have alluded, there is a further consideration which Prof. Huxley feels it necessary to mention, but which he evades by an extraordinary inconsequence. He alleges that the story of the Gadarene swine involves fabulous matter, and that this discredits the trustworthiness of the whole Gospel record. But he says:

At this point a very obvious objection arises and deserves full and candid consideration. It may be said that critical skepticism carried to the length suggested is historical pyrrhonism; that if we are to altogether discredit an ancient or a modern historian because he has assumed fabulous matter to be true, it will be as well to give up paying any attention to history. . . . Of course (he acknowledges) this is perfectly true. I am afraid there is no man alive whose witness could be accepted, if the condition precedent were proof that he had never invented and promulgated a myth.

The question, then, which Prof. Huxley himself raises, and which he had to answer, was this: Why is the general evidence of the Gospels, on the main facts of our Lord's life and teaching, to be discredited, even if it be true that they have invented or promulgated a myth about the Gadarene swine? What is his answer to that simple and broad question? Strange to say, absolutely none at all! He leaves this vital question without any answer, and goes back to the Gadarene swine. The question he raises is whether the supposed incredibility of the story of the Gadarene swine involves the general untrustworthiness of the story of the Gospels; and his conclusion is that it involves the incredibility of the story of the Gadarene swine. A more complete evasion of his own question it would be difficult to imagine. As Prof. Huxley almost challenges me to state what I think of that story, I have only to say that I fully believe it, and moreover that Prof. Huxley, in this very article, has removed the only consideration which would have been a serious obstacle to my belief. If he were prepared to say, on his high scientific authority, that the narrative involves a contradiction of established scientific truth, I could not but defer to such a decision, and I might be driven to consider those possibilities of interpolation in the narrative, which Prof. Huxley is good enough to suggest to all who feel the improbability of the story too much for them. But Prof. Huxley expressly says:

I admit I have no *a priori* objection to offer. . . . For anything I can absolutely prove to the contrary, there may be spiritual things capable of the same transmigration, with like effects. . . . So I declare, as plainly as I can, that I am unable to show cause why these transferable devils should not exist.

Very well, then, as the highest science of the day is unable to show cause against the possibility of the narrative, and as I regard the Gospels as containing the evidence of trustworthy persons who were contemporary with the events narrated, and as their general veracity carries to my mind the greatest possible weight, I accept their statement in this, as in other instances. Prof. Huxley ventures "to doubt whether at this present moment any Protestant theologian, who has a reputation to lose, will say that he believes the Gadarene story." He will judge whether I fall under his description; but I repeat that I believe it, and that he has removed the only objection to my believing it.

However, to turn finally to the important fact of external evidence. Prof. Huxley reiterates, again and again, that the verdict of scientific criticism is decisive against the supposition that we possess in the four Gospels the authentic and contemporary evidence of known writers. He repeats, "without the slightest fear of refutation, that the four Gospels, as they have come to us, are the work of unknown writers." In particular, he challenges my allegation of "M. Renan's practical surrender of the adverse case"; and he adds the following observations, to which I beg the reader's particular attention:

I thought (he says) I knew M. Renan's works pretty well, but I have contrived to miss this "practical"—(I wish Dr. Wace had defined the scope of that useful adjective)—surrender. However, as Dr. Wace can find no difficulty in pointing out the passage of M. Renan's writings, by which he feels justified in making his statement, I shall wait for further enlightenment, contenting myself, for the present, with remarking that if M. Renan were to retract and do penance in Notre Dame to-morrow for any contributions to biblical criticism that may be specially his property, the main results of that criticism, as they are set forth in the works of Strauss, Baur, Reuss, and Volkmar, for example, would not be sensibly affected.

Let me begin, then, by enlightening Prof. Huxley about M. Renan's surrender. I have the less difficulty in doing so as the passages he has contrived to miss have been collected by me already in a little tract on the "Authenticity of the Gospels," * and in some lectures on the "Gospel and its Witnesses"; † and I shall take the liberty, for convenience' sake, of repeating some of the observations there made.

I beg first to refer to the preface to M. Renan's "Vie de Jésus." ‡ There M. Renan says:

As to Luke, doubt is scarcely possible. The Gospel of St. Luke is a regular composition, founded upon earlier documents. It is the work of an author who chooses, curtails, combines. The author of this Gospel is certainly the same as the author of the Acts of the Apostles. Now, the author of the Acts seems to be a companion of St. Paul—a character which accords completely with St. Luke. I know that more than one objection may be opposed to this reasoning; but one thing at all events is beyond doubt, namely, that the author of the third Gospel and of the Acts is a man who belonged to the second apostolic generation; and this suffices for our purpose. The date of this Gospel, moreover, may be determined with sufficient precision by considerations drawn from the book itself. The twenty-first chapter of St. Luke, which is inseparable from the rest of the work, was certainly written after the siege of Jerusalem, but not long after. We are, therefore, here on solid ground, for we are dealing with a work proceeding entirely from the same hand, and possessing the most complete unity.

It may be important to observe that this admission has been supported by M. Renan's further investigations, as expressed in his subsequent volume on "The Apostles." In the preface to that

* Religious Tract Society. † John Murray, 1883. ‡ Fifteenth edition, p. xlix.

volume he discusses fully the nature and value of the narrative contained in the Acts of the Apostles, and he pronounces the following decided opinions as to the authorship of that book, and its connection with the Gospel of St. Luke (page x *sq.*):

> One point which is beyond question is that the Acts are by the same author as the third Gospel, and are a continuation of that Gospel. One need not stop to prove this proposition, which has never been seriously contested. The prefaces at the commencement of each work, the dedication of each to Theophilus, the perfect resemblance of style and of ideas, furnish on this point abundant demonstrations.
>
> A second proposition, which has not the same certainty, but which may, however, be regarded as extremely probable, is that the author of the Acts is a disciple of Paul, who accompanied him for a considerable part of his travels.

At a first glance, M. Renan observes, this proposition appears indubitable, from the fact that the author, on so many occasions, uses the pronoun "we," indicating that on those occasions he was one of the apostolic band by whom St. Paul was accompanied. "One may even be astonished that a proposition apparently so evident should have found persons to contest it." He notices, however, the difficulties which have been raised on the point, and then proceeds as follows (page 14):

> Must we be checked by these objections? I think not; and I persist in believing that the person who finally prepared the Acts is really the disciple of Paul, who says "we" in the last chapters. All difficulties, however insoluble they may appear, ought to be, if not dismissed, at least held in suspense, by an argument so decisive as that which results from the use of this word "we."

He then observes that MSS. and tradition combine in assigning the third Gospel to a certain Luke, and that it is scarcely conceivable that a name in other respects obscure should have been attributed to so important a work for any other reason than that it was the name of the real author. Luke, he says, had no place in tradition, in legend, or in history, when these two treatises were ascribed to him. M. Renan concludes in the following words: "We think, therefore, that the author of the third Gospel and of the Acts is in all reality Luke, the disciple of Paul."

Now let the import of these expressions of opinion be duly weighed. Of course, M. Renan's judgments are not to be regarded as affording in themselves any adequate basis for our acceptance of the authenticity of the chief books of the New Testament. The Acts of the Apostles and the four Gospels bear on their face certain positive claims, on the faith of which they have been accepted in all ages of the Church; and they do not rest, in the first instance, on the authority of any modern critic. But though M. Renan would be a very unsatisfactory witness to rely upon for the purpose of positive testimony to the Gospels, his estimates of the value of modern critical objections to those sacred books have

all the weight of the admissions of a hostile witness. No one doubts his familiarity with the whole range of the criticism represented by such names as Strauss and Baur, and no one questions his disposition to give full weight to every objection which that criticism can urge. Even without assuming that he is prejudiced on either one side or the other, it will be admitted on all hands that he is more favorably disposed than otherwise to such criticism as Prof. Huxley relies on. When, therefore, with this full knowledge of the literature of the subject, such a writer comes to the conclusion that the criticism in question has entirely failed to make good its case on a point like that of the authorship of St. Luke's Gospel, we are at least justified in concluding that critical objections do not possess the weight which unbelievers or skeptics are wont to assign to them. M. Renan, in a word, is no adequate witness to the Gospels; but he is a very significant witness as to the value of modern critical objections to them.

Let us pass to the two other so-called "synoptical" Gospels. With respect to St. Matthew, M. Renan says in the same preface ("Vie de Jésus," p. lxxxi):

> To sum up, I admit the four canonical Gospels as serious documents. All go back to the age which followed the death of Jesus; but their historical value is very diverse. St. Matthew evidently deserves peculiar confidence for the discourses. Here are "the oracles," the very notes taken while the memory of the instruction of Jesus was living and definite. A kind of flashing brightness at once sweet and terrible, a divine force, if I may so say, underlies these words, detaches them from the context, and renders them easily recognizable by the critic.

In respect again to St. Mark, he says (p. lxxxii):

> The Gospel of St. Mark is the one of the three synoptics which has remained the most ancient, the most original, and to which the least of later additions have been made. The details of fact possess in St. Mark a definiteness which we seek in vain in the other evangelists. He is fond of reporting certain sayings of our Lord in Syro-Chaldaic. He is full of minute observations, proceeding, beyond doubt, from an eye-witness. There is nothing to conflict with the supposition that this eye-witness, who had evidently followed Jesus, who had loved him and watched him in close intimacy, and who had preserved a vivid image of him, was the apostle Peter himself, as Papias has it.

I call these admissions a "practical surrender" of the adverse case, as stated by critics like Strauss and Baur, who denied that we had in the Gospels contemporary evidence, and I do not think it necessary to define the adjective, in order to please Prof. Huxley's appetite for definitions. At the very least it is a direct contradiction of Prof. Huxley's statement * that we know "absolutely nothing" of "the originator or originators" of the narratives in the first three Gospels; and it is an equally direct contradiction of the case, on which his main reply to my paper is based, that we

* "Popular Science Monthly" for April, 1889, p. 756.

have no trustworthy evidence of what our Lord taught and believed.

But Prof. Huxley seems to have been apprehensive that M. Renan would fail him, for he proceeds, in the passage I have quoted, to throw him over and to take refuge behind "the main results of biblical criticism, as they are set forth in the works of Strauss, Baur, Reuss, and Volkmar, for example." It is scarcely comprehensible how a writer, who has acquaintance enough with this subject to venture on Prof. Huxley's sweeping assertions, can have ventured to couple together those four names for such a purpose. "Strauss, Baur, Reuss, and Volkmar"! Why, they are absolutely destructive of one another! Baur rejected Strauss's theory and set up one of his own; while Reuss and Volkmar in their turn have each dealt fatal blows at Baur's. As to Strauss, I need not spend more time on him than to quote the sentence in which Baur himself puts him out of court on this particular controversy. He says,* "The chief peculiarity of Strauss's work is, that it is a criticism of the Gospel history without a criticism of the Gospels." Strauss, in fact, explained the miraculous stories in the Gospels by resolving them into myths, and it was of no importance to his theory how the documents originated. But Baur endeavored, by a minute criticism of the Gospels themselves, to investigate the historical circumstances of their origin; and he maintained that they were *Tendenz-Schriften*, compiled in the second century, with polemical purposes. Volkmar, however, is in direct conflict with Baur on this point, and in the very work to which Prof. Huxley refers,† he enumerates (p. 18) among "the written testimonies of the first century"—besides St. Paul's epistles to the Galatians, Corinthians, and Romans, and the apocalypse of St. John—"the Gospel of Jesus Christ, the Son of God, according to John Mark of Jerusalem, written a few years after the destruction of Jerusalem, between the years 70 and 80 of our reckoning—about 75, probably; to be precise, about 73," and he proceeds to give a detailed account of it, "according to the oldest text, and particularly the Vatican text," as indispensable to his account of Jesus of Nazareth. He treats it as written (p. 172) either by John Mark of Jerusalem himself, or by a younger friend of his. Baur, therefore, having upset Strauss, Volkmar proceeds to upset Baur; and what does Reuss do? I quote again from that splendid French edition of the Bible, on which Prof. Huxley so much relies. On page 88 of Reuss's introduction to the synoptic Gospels, he sums up "the results he believes to have been obtained by critical analysis," under thirteen heads; and the following are some of them:

* "Kritische Untersuchungen über die kanonischen Evangelien," 1847, p. 41.

† "Jesus Nazarenus und die erste christliche Zeit," 1882.

2. Of the three synoptic Gospels one only, that which ecclesiastical tradition agrees in attributing to Luke, has reached us in its primitive form.

3. Luke could draw his knowledge of the Gospel history partly from oral information; he was able, in Palestine itself, to receive direct communications from immediate witnesses. . . . We may think especially here of the history of the passion and the resurrection, and perhaps also of some other passages of which he is the sole narrator.

4. A book, which an ancient and respectable testimony attributes to Mark, the disciple of Peter, was certainly used by St. Luke as the principal source of the portion of his Gospel between chapter iv, 31, and ix, 50; and between xviii, 15, and xxi, 38.

5. According to all probability, the book of Mark, consulted by Luke, comprised in its primitive form what we read in the present day from Mark i, 21, to xiii, 37.

It seems unnecessary, for the purpose of estimating the value of Prof. Huxley's appeal to these critics, to quote any more. It appears from these statements of Reuss that if "the results of biblical criticism," as represented by him, are to be trusted, we have the whole third Gospel in its primitive form, as it was written by St. Luke; and in this, as we have seen, Reuss is in entire agreement with Renan. But besides this, a previous book written by Mark, St. Peter's disciple, was certainly in existence before Luke's Gospel, and was used by Luke; and in all probability this book was, in its primitive form, the greater part of our present Gospel of St. Mark.

Such are those "results of biblical criticism" to which Prof. Huxley has appealed; and we may fairly judge by these not only of the value of his special contention in reply to my paper, but of the worth of the sweeping assertions he, and writers like him, are given to making about modern critical science. Prof. Huxley says that we know "absolutely nothing" about the originators of the Gospel narratives, and he appeals to criticism in the persons of Volkmar and Reuss. Volkmar says that the second Gospel is really either by St. Mark or by one of his friends, and was written about the year 75. Reuss says that the third Gospel, as we now have it, was really by St. Luke. Now Prof. Huxley is, of course, entitled to his own opinion; but he is not entitled to quote authorities in support of his opinion when they are in direct opposition to it. He asserts, without the slightest fear of refutation, that "the four Gospels, as they have come to us, are the work of unknown writers." His arguments in defense of such a position will be listened to with respect: but let it be borne in mind that the opposite arguments he has got to meet are not only those of orthodox critics like myself, but those of Renan, of Volkmar, and of Reuss—I may add of Pfleiderer, well known in this country by his Hibbert Lectures, who, in his recent work on original Christianity, attributes most positively the second Gospel in its present

form to St. Mark, and declares that there is no ground whatever for that supposition of an *Ur-Marcus*—that is an original groundwork—from which Prof. Huxley alleges that "at the present time there is no visible escape." If I were such an authority on morality as Prof. Huxley, I might perhaps use some unpleasant language respecting this vague assumption of criticism being all on his side, when it, in fact, directly contradicts him; and his case is not the only one to which such strictures might be applied. In "Robert Elsmere," for example, there is some vaporing about the "great critical operation of the present century" having destroyed the historical basis of the Gospel narrative. As a matter of fact, as we have seen, the great critical operation has resulted, according to the testimony of the critics whom Prof. Huxley himself selects, in establishing the fact that we possess contemporary records of our Lord's life from persons who were either eye-witnesses, or who were in direct communication with eye-witnesses, on the very scene in which it was passed. Either Prof. Huxley's own witnesses are not to be trusted, or Prof. Huxley's allegations are rash and unfounded. Conclusions which are denied by Volkmar, denied by Renan, denied by Reuss, are not to be thrown at our heads with a superior air, as if they could not be reasonably doubted. The great result of the critical operation of this century has, in fact, been to prove that the contention with which it started in the persons of Strauss and Baur, that we have no contemporary records of Christ's life, is wholly untenable. It has not convinced any of the living critics to whom Prof. Huxley appeals; and if he, or any similar writer, still maintains such an assertion, let it be understood that he stands alone against the leading critics of Europe in the present day.

Perhaps I need say no more for the present in reply to Prof. Huxley. I have, I think, shown that he has evaded my point; he has evaded his own points; he has misquoted my words; he has misrepresented the results of the very criticism to which he appeals; and he rests his case on assumptions which his own authorities repudiate. The questions he touches are very grave ones, not to be adequately treated in a review article. But I should have supposed it a point of scientific morality to treat them, if they are to be treated, with accuracy of reference and strictness of argument.

II.

By W. C. MAGEE,

BISHOP OF PETERBOROUGH.

I SHOULD be wanting in the respect which I sincerely entertain for Prof. Huxley if I were not to answer his "appeal" to me in the last number of this review for my opinion on a point in controversy between him and Dr. Wace. Prof. Huxley asks me,

"in the name of all that is Hibernian, why a man should be expected to call himself a miscreant or an infidel"? I might reply to this after the alleged fashion of my countrymen by asking him another question, namely—When or where did I ever say that I expected him to call himself by either of these names? I can not remember having said anything that even remotely implied this, and I do not therefore exactly see why he should appeal to my confused "Hibernian" judgment to decide such a question.

As he has done so, however, I reply that I think it unreasonable to expect a man to call himself anything unless and until good and sufficient reason has been given him why he should do so. We are all of us bad judges as to what we are and as to what we should therefore be called. Other persons classify us according to what they know, or think they know, of our characters or opinions, sometimes correctly, sometimes incorrectly. And were I to find myself apparently incorrectly classified, as I very often do, I should be quite content with asking the person who had so classified me, first to define his terms, and next to show that these, as defined, were correctly applied to me. If he succeeded in doing this, I should accept his designation of me without hesitation, inasmuch as I should be sorry to call myself by a false name.

In this case, accordingly, if I might venture a suggestion to Prof. Huxley, it would be that the term "infidel" is capable of definition, and that when Dr. Wace has defined it, if the professor accept his definition, it would remain for them to decide between them whether Prof. Huxley's utterances do or do not bring him under the category of infidels, as so defined. Then, if it could be clearly proved that they do, from what I know of Prof. Huxley's love of scientific accuracy and his courage and candor, I certainly should expect that he would call himself an infidel—and a miscreant too, in the original and etymological sense of that unfortunate term, and that he would even glory in those titles. If they should not be so proved to be applicable, then I should hold it to be as unreasonable to expect him to call himself by such names as he, I suppose, would hold it to be to expect us Christians to admit, without better reason than he has yet given us, that Christianity is "the sorry stuff" which, with his "profoundly" moral readiness to say "unpleasant" things, he is pleased to say that it is.

There is another reference to myself, however, in the professor's article as to which I feel that he has a better right to appeal to me—or, rather, against me, to the readers of this review—and that is, as to my use, in my speech at the Manchester Congress, of the expression "cowardly agnosticism." I have not the report of my speech before me, and am writing, therefore, from memory; but my memory or the report must have played

me sadly false if I am made to describe all agnostics as cowardly. A much slighter knowledge than I possess of Prof. Huxley's writings would have certainly prevented my applying to all agnosticism or agnostics such an epithet.

What I intended to express, and what I think I did express by this phrase was, that there is an agnosticism which is cowardly. And this I am convinced that there is, and that there is a great deal of it too, just now. There is an agnosticism which is simply the cowardly escaping from the pain and difficulty of contemplating and trying to solve the terrible problems of life by the help of the convenient phrase, "I don't know," which very often means "I don't care." "We don't know anything, don't you know, about these things. Prof. Huxley, don't you know, says that we do not, and I agree with him. Let us split a B. and S."

There is, I fear, a very large amount of this kind of agnosticism among the more youthful professors of that philosophy, and indeed among a large number of easy-going, comfortable men of the world, as they call themselves, who find agnosticism a pleasant shelter from the trouble of thought and the pain of effort and self-denial. And if I remember rightly it was of such agnostics I was speaking when I described them as "chatterers in our clubs and drawing-rooms," and as "freethinkers who had yet to learn to think."

There is therefore in my opinion *a* cowardly agnosticism just as there is also *a* cowardly Christianity. A Christian who spends his whole life in the selfish aim of saving his own soul, and never troubles himself with trying to help to save other men, either from destruction in the next world or from pain and suffering here, is a cowardly Christian. The eremites of the early days of Christianity, who fled away from their place in the world where God had put them, to spend solitary and, as they thought, safer lives in the wilderness, were typical examples of such cowardice. But in saying that there is such a thing as *a* cowardly Christianity, I do not thereby allege that there is no Christianity which is not cowardly. Similarly, when I speak of *a* cowardly agnosticism, I do not thereby allege that there is no agnosticism which is not cowardly, or which may not be as fearless as Prof. Huxley has always shown himself to be.

I hope that I have now satisfied the professor on the two points on which he has appealed to me. There is much in the other parts of his article which tempts me to reply. But I have a dislike to thrusting myself into other men's disputes, more especially when a combatant like Dr. Wace, so much more competent than myself, is in the field. I leave the professor in his hands, with the anticipation that he will succeed in showing him that a scientist dealing with questions of theology or biblical criticism may

go quite as far astray as theologians often do in dealing with questions of science.

My reply to Prof. Huxley is accordingly confined to the strictly personal questions raised by his references to myself. I hope that, after making due allowance for Hibernicisms and for imperfect acquaintance with English modes of thought and expression, he will accept my explanation as sufficient.—*Nineteenth Century.*

## GROWTH OF THE BEET-SUGAR INDUSTRY.

By A. H. ALMY.

THE statistics collected from the sugar-producing countries show that more than one half of the world's sugar is derived from the beet-root; and it is known that the consumers of sugar in the United States often make daily use of it in their households without suspecting that they are contributing to the support of the peasantry and wage-earners of continental Europe.

Whenever the history of the beet-sugar industry shall have been written, it will prove interesting and instructive to the student, as an achievement of science, and will present a problem to the political economist of grave import in its reflection on the future business possibilities. It is a matter of historical record that for many years, in the early part of the present century, continental Europe worked almost hopelessly to produce a sugar-yielding plant which would thrive in its northern climate and supply the sugar it consumed.

Chemistry had demonstrated that the beet-root—as well as other forms of plant-life—contained a solution of sugar identical with that found in the cane-plant of the tropics; but the amount of sugar extracted was so inconsiderable as to preclude the hope of obtaining a supply from that source, unless new discoveries should make it possible to increase the saccharine product.

Schools of instruction were established for imparting special information in the cultivation of the beet and the extraction of the saccharine principle. And costly experiments and researches were made.

Scientific men were rewarded, subsidies were granted, and factories were built, but sugar was produced only at extravagant cost; and, as a financial venture, without other considerations, it proved a stupendous failure. The industry was abandoned in France with the fall of Napoleon, but was continued in a moderate way by some of the continental states without a profitable result, until about twenty years ago, when the possible war complications of that period—which afterward culminated in the humilia-

tion of France—forced Germany to rehabilitate her agricultural industries, from which the armies of the empire were chiefly supplied. Her lands were worn under a thousand years of tillage without rotation of crops, and had more recently become unprofitable and valueless under the vain attempt to produce the staple crops of grain in competition with the rich prairies of our Northwest, and her farmers were emigrating to America. The soil was not exhausted, as many have supposed, but, like our own farms in New England, laboring at present under the same difficulties, required a diversity of culture and new fertilization. Their previous experiments had shown that the beet-root, depending largely for its growth upon the atmosphere, did not exhaust the soil, as was the case in the cultivation of grain, but, in rotation with the staple crops, like wheat, barley, and rye, it left the land richer for the following crop. Besides, the beet-root was peculiarly a product of the temperate zone—indigenous to the latitude of northern France and Germany, requiring fair skies, sunlight, and long seasons, for the full perfection of its growth for sugar-making purposes. It could not be raised profitably for saccharine extraction on the sea-coast, as it easily absorbed saline matters, or in the dark and damp places of England, or in the higher latitudes, where the season is too short to ripen the plant to perfection, any more than it would thrive in the hot climate of the South.

A new system of excise duties was established which induced the farmer to enter into the growing of beets on a larger scale, and bounties were given to attract capital into the construction of factories for the manufacture of beet-sugar. This excise tax, not unlike that of our own internal revenue collection on whisky and tobacco—where the consumer pays the tax—was equal to two and a half cents per pound on the sugar extracted from the beet. To the sugar exporter the tax was returned, and there was also paid a bonus which assumed the character of an export bounty.

Under these conditions an enormous increase of sugar production and a rapidly augmented exportation of sugar followed. The farmer commenced a new system of fertilization that produced larger crops, and began with energy to develop from the soil the nitrogen which the chemists had found to be so much needed in the cultivation of the beet-root. He made more manure on the farm by feeding his cattle with the pulp, received from the factories that had sprung up like magic a residuum derived from the chemical processes in the extraction of sugar containing all the salts and elements remaining, thus giving a new impulse to cattle-raising and dairy products from its rich fodder.

Gathering from twenty to twenty-five tons of beets from an

acre, each ton yielding from one hundred and fifty to two hundred pounds of sugar, which gave him three times the profit that he had hitherto derived from the cultivation of wheat, rye, barley, and the staple crops, leaving the land better prepared to receive the annual plant in its rotation with the beet, he found the value of his farm increasing enormously, and his prosperity phenomenal, as the swarms of peasants—men, women, and children—flocked to his growing fields or followed the harvesting, while full employment was given to the general wage-earner and the artisan.

New employments and collateral industries increased in the same ratio; railroads were projected and built to transport the beet-root from the interior farms to the great factories scattered for hundreds of miles throughout Germany, long trains of platform-cars, often numbering fifty to sixty, piled full of white sugar-beets, met the eye of the traveler during the harvesting season, and speculation ran high with the fabulous profits of the sugar manufacturers.

Subsequently the attempt to manufacture beet-sugar in the Southern United States met with signal failure. Later, beet-sugar factories were started in the Northern States, in the latitude of Germany, where the soil and meteorological conditions were equal to the best of beet-growing sections on the Continent; to which was added the long Indian summer, which can not be approached by any country in its advantages for maturing the plant. To these factories, erected in different sections of the North, subsidies were granted and bounties were given by several of the States in which they were located, fostered and assisted by the Agricultural Bureau and experimental stations of the Government; yet they were overcome by the same difficulties that had for fifty years and more confronted their foreign pioneers, and they, one and all, came to grief in their attempts to manufacture sugar from the beet-root at a profit, for the metamorphosis of the plant and the sugar-beet process had not yet been developed.

But during the last decade great discoveries have been made in the cultivation of the root, as well as in the methods for the extraction of the solution of sugar by ingenious mechanical devices, and the sugar-beet of to-day bears no resemblance to that of the past century, either in its form or the minerals it contains; and the saccharine principle has been increased a thousand per cent above the extraction of one per cent secured by the early experiments of Archaud in the days of the first Napoleon. Forty years afterward the chemists found their experimentation had increased the product to six per cent only, and a quarter of a century later the highest attainable result proved that it required twelve and a half parts of beet-root to produce one part of grain sugar, about one eighth per cent of the whole, which was the

basis on which the German excise duty was established; yet last year the statistical organ of the German Empire reports an average extraction of thirteen per cent. The employment of an ingenious contrivance known as the "diffusion battery"—though simple in its conception, nevertheless illustrates well-known laws of chemical science in the transfusion of liquids, and successfully opens the membranous walls of the sugar-cells of the plant, giving a higher grade of juice, with less gummy, nitrogenous, and fibrous impurities, at less cost than by the old methods of mechanical pressure—has in no small degree contributed to this result. It had taken three quarters of a century to develop the chemistry and the mechanical adjustment of the sugar-beet processes, and even now we notice that the progress in this direction is great.

Meantime France, Belgium, Austria-Hungary, Poland, Russia, and other countries in continental Europe, after a series of unsuccessful attempts, resumed the manufacture of beet-sugar, and by a system of subsidies, bounties, and drawbacks, notwithstanding the many climatic and meteorological difficulties, produced a large quantity of sugar, but little as compared with Germany, as is shown by the following table, estimating the production of beet-sugar in the year 1885:

| | |
|---|---|
| German Empire | 1,155,000 tons. |
| France | 308,000 " |
| Belgium | 88,000 " |
| Austria-Hungary | 558,000 " |
| Russia and Poland | 387,000 " |
| Holland and other countries | 50,000 " |
| | 2,546,000 " |

The entire production of cane-sugar in Cuba, Java, Brazil, Peru, British India, Egypt, Manila, Louisiana, and other cane-sugar producing countries, during the same period, did not exceed 2,260,100 tons, or less than one half of the world's sugar production.

The simple and inexpensive methods adopted in the German factories have made the beet-sugar manufacture one of the most profitable of industries, and the work goes on day and night, at a prime cost for conversion of two dollars per ton of beets, or one cent per pound of sugar, not estimating the cost of the beet-root, but including labor and all materials used, like coal, coke, lime, charcoal, wear and tear, and interest on the invested capital. The monthly disbursements of such an establishment exceed sixty thousand dollars, and give employment to thousands of wage-earners in direct and collateral industries. One sugar corporation in France reported a net profit derived from the manufacture of beet-sugar a few years ago of two millions of dollars, and the season did not extend beyond one hundred and twenty days. Under

these new conditions the production of beet-sugar in continental Europe has doubled in the last decade; and, after the home populations are supplied, the surplus is exported to Great Britain and the United States, reducing the price of sugar in the markets of the world more than fifty per cent.

The sugar-refineries of this country use the beet- and cane-sugar indiscriminately in the manufacture of the block sugar of commerce, and the family grocer sells the imported refined beet-sugar at a price from twenty-five to fifty per cent above the price of cane-sugar.

Before our late war, Louisiana produced more sugar than Germany; and although the beet-sugar industry in the latter country was greatly stimulated by the high prices of sugar prevailing, incident to the entire destruction of the cane-sugar industry of the United States, yet as late as 1875 the empire produced only twenty-five hundred tons, while for the year 1888 a production of one million three hundred thousand tons of sugar and saccharine resultants is recorded.

If the increasing production of continental sugar continues in the same ratio as in the past, it needs no prophet to foretell the future of the cane-sugar colonies. Even now the English market can not afford to take colonial cane-sugar, although it is admitted free of duty. The English refining factories, which represent an investment of fifteen or twenty millions of dollars, and have hitherto supported a large population of wage-earners, are being closed, from the competition with continental sugar.

These questions are attracting the attention of all the governments of Europe; and while a number of members of the British Parliament tried to find compensation for the losses of the cane-sugar colonies, and the destruction of the British sugar-refineries, in the circumstance that the consumers of sugar in Great Britain saved fifty-five millions of dollars annually, in the reduced cost of an article of prime necessity of which the consumption had increased thirty-three per cent within a few years; yet an international congress was determined upon, for the purpose of doing away, if possible, with all bounties on sugar manufacture.

This grave question was presented, in all its bearings, to the Parliaments, Finance Ministers, Boards of Trade, and Chambers of Commerce of many of the Continental Governments, but at the gathering in London the proposition met with little or no favor.

After the adjournment of the congress the German Empire announced a new excise duty, which took effect last August, involving all the principles of the old duties, and increased the "material and consumption" tax on beets to three cents per pound on sugar as against two and a half cents per pound previously,

and fixed the export bounty at two cents and two and a half cents per pound on raw and refined sugar respectively.

During the past year large capital has been attracted toward the development of the sugar-beet industry in the United States on the Pacific coast. Although that section of the country, with its peculiar surroundings, does not generally present the meteorological and climatic conditions necessary to secure the best results in the cultivation of the beet-root for sugar-making purposes, yet a factory was started last October, with equipment and machinery capable of reducing three hundred and fifty tons of beets per diem, and has proved a great financial success. A full supply of beets, cultivated by the wheat-growers of California, kept the works fully employed, and a boom was given to the town of Watsonville. The factory consumes seven tons of lime daily in the chemical processes of extracting the sugar, which is distributed pro rata to the grower of beets free, and can be returned to the soil. Besides, the farmers averaged over eighty dollars per acre for their beet products, while the recent report of the Agricultural Bureau estimates the returns from the total production of the five principal crops—oats, corn, rye, barley, and wheat—in the United States to be less than twelve dollars per acre as an average.

The beet-root, deriving its fertilization from previous crops of annuals, can not rotate effectually with the cereals, except in the third season; and of course the comparative estimate of increased profit over wheat is not as large as it would be if the plant admitted of continuous culture, and thus may be misleading.

When we take into consideration the elements—organic and mineral—of which all plants are composed, and that each variety requires for its perfect development certain meteorological conditions, peculiar characters of soil, and combinations of the various leading constituents of plant-food, which have enlisted the energies of scientists for years in continued investigation, we are struck with admiration and wonder at the progress of agricultural chemistry—not only in revealing the chemicals as they exist, replacing them in the soil when exhausted by cultivation, but in transforming a root and making almost a new creation, by extracting the noxious minerals which had retarded its development, with simply special culture.

It is admitted that the new appliances of steam and electricity and the inventions of the past quarter of a century have changed the commerce of civilization, but, as economic factors, these can scarcely prove more far-reaching in their influence than those discoveries of science, in the same period, which have made it possible to open a new industry in a northern latitude for the

manufacture of an article of prime necessity, whose habitat has been for a century in the tropics.

The chemists have found that the four principal elements which enter into plant-life are met every day, only under other names and slightly different forms. Nitrogen in one form is the ammonia of commerce. Potash is simply lye from wood-ashes. Phosphoric acid is ground bones dissolved in acid; and lime is seen everywhere. These represent the necessary nutrition of the beet-root when the climatic conditions are favorable; but if they exist in insoluble combination, they will be useless in the economy of nutrition, or if in form suitable for similation, but excessive in quantities, they will stimulate the plant to abnormal growth, unsuited to its desired perfection.

The scientists have shown us how to cultivate the beet for sugar-making; that soils charged with mineral salts are injurious to its development for that purpose; that, in fact, the beet easily absorbs saline matters, while the alkaline salts constitute one of the greatest obstacles to sugar extraction. They say new ground, or that lately cleared of forest, should not be applied to the culture of the beet, but the land used for this purpose should have been under continued cultivation at least ten or fifteen years for the removal of the nitrates and the organic matter containing nitrogen, which are always present in new soils, and exert an injurious influence on the quality of the root.

We now have elaborate tables of analyses of soils to show the chemical composition of those most favorable to the culture, as well as to the physical character which render them best suited to the cultivation of the beet, their porosity and subsoil conditions.

Unless the supply of the elements of plant-food is continuous and regular, a purely sandy soil would be undesirable. If no means are provided for the removal of surplus water which may be found in a purely clay soil, or to so improve its condition as to admit of free circulation of air as well as water, it will be too heavy, and become absolutely useless. The same is true of purely calcareous soil, since the same unfavorable conditions would prevail, though perhaps to not quite the same extent. Such soils would also be unsuited to the plant itself, because they would not admit of the free progress of the tap-root nor of the lateral fibrous roots in their search for nutrition. These conditions have a powerful influence upon the ultimate yield of sugar from the surface cultivated.

But if the sandy soil be mixed with either or both of the others, and with humus—*pulverulent brown earth*—in suitable proportions, the conditions most favorable to the maintenance of a regular and plentiful supply of food, the healthy condition of the root and its consequent normal development will be assured.

The beet-root, as a biennial plant, enters readily into rotation with annual plants, and with those plants known to exhaust the soil. It precedes barley, wheat, rye, and oats, and prepares the soil in a marvelous manner for cereals, the subsequent fertilization of which prepares the soil for the beet. The land must not receive fertilizing treatment during the season of the growth of the beet-root, but must be well prepared—not too light, not too moist; it should be warm, rich in humus, deep and free from stones, like a garden. The form of the beet desired for greater sugar extraction would, with this physical condition, be long and tapering.

In this collection of data, derived from the best authorities in Europe, where the cultivation of the beet is best managed, it will not be possible to speak of the meteorological conditions necessary to the perfect growth of the root for sugar-producing purposes, except to say that the principal conditions to be studied in this connection are those of the temperature and moisture with which the plant may be surrounded. The amount of moisture at the disposition of the plant, at all seasons of its growth, is the most important factor in its normal development. Temperature has an influence: if it be too low or too high, it has the same power of evil as a deficiency of moisture. Various sections of the United States north of Mason and Dixon's line, where the rainfall is regular, like New England, with its long Indian summer, present all the conditions to produce the sugar-beet to perfection.

The cultivation of the root, and the latest approved processes for extracting the sugar, will be considered hereafter.

## EGGS IN CHEMISTRY AND COMMERCE.

By P. L. SIMMONDS, F. L. S.

WHAT a subject scientific research has found in eggs as a study, witness the works of Moquin-Tandon and O. des Murs.* These publications serve to show how the oölogic characteristics may assist in the methodical classification of birds, what relation there is between the egg and the organic conformation of the bird, and what particular habits of birds may be gathered from a study of their eggs and nests.

Some birds only lay a single egg, others many. The largest ordinary number, on the average, is five or seven. The species laying less are more rare than the species laying a larger number. Those in a state of liberty produce, on the average, twelve to fifteen. But in domestic poultry the number is larger. Farm-

* "Traité Général d'Oologie Ornithologique," par P. O. des Murs.

yard hens average sixty or seventy eggs in the year, and certain Cochin-China fowls are said to lay from two hundred to three hundred eggs. The number of eggs laid is less at the commencement and end of life. With hens, for instance, the number laid is less in the first and fourth year than in the second and third, and after the fifth year, generally, they cease laying. Chickens and ducklings, which can generally shift for themselves soon after emerging from the egg, are more numerous in a brood than young pigeons, which have to be fed by the parent. But if pigeons only lay two eggs at a time, they lay more frequently—once or twice a month—and hence rear a large number of young.

In form and general aspect the difference among birds' eggs is endless. Some are elongated, some are spherical, some are dull on the surface, some are polished, some are dark, others gray or white, others very bright. The shape of eggs offers as much diversity as their size and weight. They may be thrown, however, into six principal or typical forms—the cylindrical, the oval, the spherical, the ovicular, oviconical, and the elliptic. The ovicular form of egg belongs to the *Passeræ* and *Gallinaceæ*, the ovoid to the rapacious birds and the *Palmipedes*, the conical to the wading birds and some *Palmipedes*, the short to some game and many stilted birds, and the spherical to nocturnal birds of prey and the kingfishers.

Mr. W. C. Hewitson observes that in their relative sizes the eggs of different birds vary in a remarkable degree from each other. The guillemot and the raven are themselves about equal in size, but their eggs differ as ten to one. The snipe and the blackbird differ but slightly in weight, their eggs remarkably. The egg of the curlew is six or eight times as large as that of the rook; the birds are about the same size. The eggs of the guillemot are as big as those of an eagle, while those of the snipe equal the eggs of the partridge and the pigeon. The reason of this great disparity in size is, however, obvious. The eggs of all those birds which quit the nest soon after they are hatched, and are consequently more fully developed at their birth, are very large, and yet so admirably formed to occupy the least possible space, that the snipe has no more difficulty in covering its eggs, though apparently so disproportionate, than the thrush or the blackbird. Hence we see that eggs are not always proportioned to the size of the birds which lay them. The standard yield and weight of eggs for the different varieties of domestic fowl are about as follow: Light Brahmas and partridge Cochins, eggs seven to the pound; they lay, according to treatment and keeping, from eighty to one hundred per annum, oftentimes more if kept well. Dark Brahmas, eight to the pound, and about seventy per annum. Black, white, and buff Cochins, eight to the pound; one hundred is a

large yield per annum. Plymouth Rocks, eight to the pound, lay one hundred per annum. Houdans, eight to the pound, lay one hundred and fifty per annum; non-sitters. La Flèche, seven to the pound, lay one hundred and thirty per annum; non-sitters. Black Spanish, seven to the pound, lay one hundred and fifty per annum. Dominiques, nine to the pound, lay one hundred and thirty per annum. Game fowl, nine to the pound, lay one hundred and thirty per annum. Crèvecœurs, seven to the pound, lay one hundred and fifty per annum. Leghorns, nine to the pound, lay from one hundred and fifty to two hundred per annum. Hamburgs, nine to the pound, lay one hundred and seventy per annum. Polish, nine to the pound, lay one hundred and fifty per annum. Bantams, sixteen to the pound, lay sixty per annum. Turkeys, eggs five to the pound, lay from thirty to sixty per annum. Ducks' eggs vary greatly with different species, but from five to six to the pound, and from fourteen to twenty-eight per annum, according to age and keeping. Geese, four to the pound, lay twenty per annum. Guinea fowls, eleven to the pound, lay sixty per annum. Large eggs have generally a thicker shell than small ones. By comparison with eggs in former times, those of improved breeds of fowls of the present day have gained one third in weight.

Exceptionally large hens' eggs are often met with. Thus, in the journal "Land and Water" for June 16, 1877, a Cochin-China fowl's egg is recorded which weighed one quarter of a pound and measured eight and five eighth inches lengthwise, six and a half inches in circumference. That of a Dorking weighing seven ounces measured seven and a half inches round the middle and nine and a half inches across the ends. Another weighed ten and a half ounces, and measured eight inches round the center and twelve and a half inches across the ends.

In the "Birmingham Mercury" of May 9, 1857:

A half-bred Cochin-China hen belonging to Mr. Campbell, carter, of Great Croft Street, Darlaston, is stated during the past few weeks to have laid eleven extraordinary eggs of an enormous size, each weighing upward of five ounces, and one when just laid weighed not less than seven ounces. On one being broken another perfect egg, of the usual size, was found inside, which led to seven being broken with the same results. Around the one weighing seven ounces (being the tenth egg) a third shell and egg had begun to form. Several of these eggs are whole, and by carefully handling them the motion of the inner eggs may be perceived. Two of the inner eggs are also preserved, and numbers of people have been to see them, and have expressed themselves highly gratified at such an extraordinary phenomenon. The hen is not above the middle size, being about four and a half pounds in weight.

Many eggs are laid naked, dry, and smooth; others are impregnated with a greasy, glutinous substance. The latter are

chiefly those of sea-birds, or those which live in moist localities. This glutinous coating is doubtless intended to preserve the eggs from the water, or to maintain the degree of heat necessary to preserve life. There are soft eggs laid entirely without shells, or with only the albuminous inner membrane. This occurs chiefly in hens that are too fat; and this failing can be remedied by supplying calcareous substances with their food.

Egg-shell is much used in medical prescriptions. When calcined at a low red heat the shells afford a very pure form of carbonate of lime. The principal use of egg-shells is, however, when blown, for the cabinets of private ornithological collections and those of public museums. The eggs of the ostrich are often mounted in silver, and form elegant drinking-cups; so are the handsome green eggs of the Australian emeu, which look as if made of dark morocco-leather. Ostrich egg-shells serve as water-vessels among the African women; necklaces made of pieces of egg-shells punched out in a circular form are worn by some African natives.

Eggs blown are sometimes used in shooting-galleries, strung as a mark or target. The smooth surface of the egg-shell can even be used for artistic purposes, and we often see ostrich-eggs and hens' eggs painted or engraved with fanciful designs.

The employment of egg-shells for ornamental purposes is extremely ancient. A MS. in the Harleian collection represents a number of egg-shells ornamented in the most elegant and costly manner; miniatures were often painted upon them with extreme care, and egg-shells thus curiously decorated became valuable and highly esteemed presents. In Venice young noblemen frequently lavished large sums of money upon portraits painted within egg-shells, intended as presents.

Those who have only seen the ordinary fowl's eggs of our shops and poultry-yards would suppose that eggs were always white. But, on examining a large collection of birds' eggs, it will be found that they are of all colors. Except, perhaps, some very clear shades, the yellow for instance, none are wanting. There are blue eggs, yellowish, green, reddish, and olive. When we consider the eggs of some nine thousand different birds known, we find that not one fifth of those of the European birds are white, and among the exotic birds the number of white is much less. The white color is not always pure; there are gray and yellow shades, more or less of a dirty hue. In colored eggs, there are uniform colors and spotted colors. Although the larger number of the races of domestic fowls lay white eggs, there are some which have a yellow or nankeen tint; these are principally Asiatic birds. Birds which build open nests seem uniformly to have

colored eggs, and those which possess concealed or covered nests, white eggs.

But few of those who break the shells of the cooked eggs of our common domestic fowls at the breakfast-table ever think of the wonderful nature of the structure they crush, or of the complex chemical nature of the contents consumed as food. The white, fragile cortex called the shell, composed of mineral matter, is not the tight, compact covering which it appears to be, for it is everywhere perforated with a multitude of holes. Under the microscope the shell appears like a sieve, or it more closely resembles the white perforated paper sold by stationers. The shell of the egg is lined upon its interior everywhere with a very thin but pretty tough membrane, which, dividing at or very near the obtuse end, forms a small bag which is filled with air. In new-laid eggs this follicle appears very small, but it becomes larger when the egg is kept. In breaking an egg this membrane is removed with the shell, to which it adheres, and therefore is regarded as a part of it, which it is not. The shell proper is made up mostly of earthy materials. The proportions vary according to the food of the bird, but ninety to ninety-seven per cent is carbonate of lime. The remainder is composed of two to five per cent of animal matter, and one to five of phosphate of lime and magnesia.

If a farmer has a flock of one hundred hens they produce in egg-shells about one hundred and thirty-seven pounds of chalk annually; and yet not a pound of the substance, or perhaps not even an ounce, exists around the farm-house within the circuit of their feeding-grounds. The materials of the manufacture are found in the food consumed, and in the sand, pebble-stones, brick-dust, bits of bones, etc., which hens and other birds are continually picking from the earth. The instinct is keen for these apparently innutritious and refractory substances, and they are devoured with as eager a relish as the cereal grains or insects. If hens are confined to barns or out-buildings, it is obvious that the egg-producing machinery can not be kept long in action unless the materials for the shell are supplied in ample abundance.

Within the shell the animal portion of the egg is found, which consists of a viscous colorless liquid called albumen, or the *white*, and a yellow globular mass called the vitellus, or *yolk*. The white of the egg consists of two parts, each of which is enveloped in distinct membranes. The outer bag of albumen, next the shell, is quite a thin, watery body, while the next, which invests the yolk, is heavy and thick. But few housekeepers who break eggs ever distinguish between the two whites, or know of their existence even. Each has its appropriate office to fulfill during the process of incubation or hatching, and one acts, in the mysterious process, as important a part as the other.

The yolk contains water and albumen, but associated with these is quite a large number of mineral and other substances, which render it very complex in composition. The bright yellow color is due to a peculiar fat or oil, which is capable of reflecting the yellow rays of light, and this holds the sulphur and phosphorus which abound in the egg.

It is well known that from the egg all the constituent parts of the young animal are formed—its skeleton, as well as its various soft textures. Now, for the construction of the skeleton an amount of earthy matter is required which does not exist preformed in the soft contents of the egg, but has to be drawn from the shell. During the process of incubation, with the co-operation of the atmospheric air which permeates the shell, it appears that the phosphorus present in the yolk gradually undergoes oxidation, and becomes converted into phosphoric acid. This acts upon and dissolves the carbonate of lime belonging to the shell, which thus, as incubation proceeds, becomes thinner and thinner. The thinning of the shell also makes it easier for the young bird to peck its way out.

An enveloping membrane or bag surrounds the yolk, and keeps the fluid matter of which it is composed together. Being lighter than the white, it floats to that portion of the egg which is uppermost, but is kept in position between the two extremities by two processes of inspissated albumen, called *chalazea*, which pass to and are attached, one to either end of the egg.

| | Entire contents. | White. | Yolk. |
|---|---|---|---|
| Nitrogenous matter | 14·0 | 20·4 | 16·0 |
| Fatty matter | 10·5 | .... | 30·7 |
| Saline matter | 1·5 | 1·6 | 1·3 |
| Water | 74·0 | 78 0 | 52·0 |
| Total | 100·0 | 100·0 | 100·0 |

The white of egg, as this shows, contains a considerably larger proportion of water than the yolk. It contains no fatty matter, but consists mainly of albumen in a dissolved state, and inclosed within very thin-walled cells. It is this arrangement which gives to the white of egg its ropy, gelatinous state. Thoroughly shaking or beating it up with water breaks the cells and removes the ropy state.

Eggs are useful for many purposes besides food and hatching. The white of an egg has proved a most efficacious remedy for burns; seven or eight successive applications of this substance soothe the pain and effectually exclude the air from the burn. This simple remedy seems preferable to collodion, or even cotton. Extraordinary stories are told of the healing properties of an oil

which is easily made of the yolks of fowls' eggs. It is in general use among the peasants of southern Russia as a means of curing cuts, bruises, and scratches. When, as sometimes by accident, sulphate of copper, or corrosive poisons generally, are swallowed, the white of one or two eggs will neutralize the poison, and change the effect to that of a dose of calomel. Raw eggs have at all times been considered an excellent remedy for debility, on account of the phosphorus contained in them, as well as a preventive of jaundice in its more malignant form. The yolk is sometimes used as a convenient medium for forming an emulsion of the thick turpentines with water. These mixtures are used as enemata.

As a flesh-producer, one pound of eggs is equal to one pound of beef. About one third of the weight of an egg is solid nutriment, which is more than can be said of meat. Eggs, at average prices, are among the cheapest and most nutritious articles of diet. Like milk, an egg is a complete food in itself. It is also easily digested, if not damaged in cooking.

The celebrated Guinod de Reynière, who consecrated his life to studying the delicacies of the table, affirms, in his "Almanach des Gourmands," that eggs can be served in more than six hundred ways, and a book is published in London by a French cook, which gives one hundred and fifty recipes for cooking eggs. The feeble man, who has regained strength by boiled eggs for several days, will continue the same comforting food when presented in the form of an omelet, which is one of the principal food preparations made with eggs.

The flavor of eggs is much influenced by the nature of the package, for they imbibe foreign odors with the greatest readiness. Eggs brought in the same ship as oranges become impregnated with the scent and flavor of the fruit. If the cases in which they are packed are made of green wood, the eggs will be ruined. The straw in which they are packed should also be perfectly dry, or it will ferment and communicate a fusty smell to the eggs.

A raw egg beaten up in a glass of wine is recommended for vocalists for clearing their voice, and in cases of debility; and a spirit of eggs is sold which is said to be useful in impaired health or the infirmities of age, when vital energy is wanting, and as a specific for soreness of the throat. The white of eggs forms an albuminous solution, useful in diarrhœa of phlegmatic origin. To make this, beat up the white of four eggs and add a quart of water slowly, remove the froth formed, add sugar, a little orange-water, and, if necessary, a dozen drops of laudanum. This albumenized water is the best antidote to a great number of mineral poisons. The phosphorus in the egg is very good for all those who have

brain-work to do. The sulphur in the yolk, as is well known, acts chemically on silver spoons, turning them black, forming a sulphide of silver that can not be removed without taking off the surface of silver, thus rapidly wearing the spoon away.

Eggs, although of animal origin, are now allowed to be eaten by Catholics during Lent. But it was not always so: formerly eggs never figured on the tables of the faithful during the fast; but, on the Saturday previous to Easter, a great quantity of eggs, held over for six weeks, was blessed and distributed among friends on Easter Sunday. They were dyed yellow, violet, and especially red, hence the origin of the red or Easter eggs. In the reigns of Louis XIV and XV, after grand mass on Easter-Sunday, pyramids of eggs gilded were taken to the cabinet of the king, who distributed them to his courtiers. The custom of Easter eggs is continued to the present time, although modified. Easter eggs are no longer blessed nor gilded to be offered to sovereigns, nor are they held over to Easter eve to receive brilliant colors. A fortnight before Easter, in the coffee-houses and beer-shops of Catholic cities, may be seen huge dishes of eggs of various colors, which are eaten by the customers with their beer. And in families a hard egg is added to the salad, after removing the colored shell.

The mutual presentation of colored eggs at Easter by friends continues in Russia and all Catholic countries. Fowls' eggs variously colored, and having flowers and other devices upon them, formed by the coloring matter being picked off, so as to expose the white shell of the egg, are a part of all the Malay entertainments in Borneo.

The eggs of the domestic fowl are the edible eggs *par excellence,* but many others can be utilized for food. The egg of the goose, which is larger, is inferior in quality; in districts where geese are bred they give, however, some benefit. The egg of the duck, with a smoother shell, smaller and less rounded, is of a greenish or dark white, the yolk is larger and of a deeper color than that of other poultry eggs, and the white by cooking attains a consistence like transparent isinglass. The egg of the pea-fowl or guinea-hen has a thick and hard shell, flesh-colored; the yolk is proportionally much larger than the white.

The common wild or gray lag goose is the origin of our domestic goose. It used to be common and bred in our fens in former years. The common goose begins to lay toward Candlemas, and lays from nine to eleven eggs. If well fed, she will lay thirty-five to forty eggs, and sometimes fifty, if the eggs are removed and she is not allowed to set. The turkey-hen lays from twelve to twenty eggs, rather smaller than those of the goose, which are white, mixed with reddish or yellow freckles. They are very

good in pastry, and mixed with fowls' eggs they improve omelets.

The question whether fowls or ducks are the better investment for the production of eggs has to some extent been settled experimentally in Germany and France in favor of ducks. They laid more eggs than the fowls, and, though they were rather smaller, they proved to be decidedly superior in nutritive material. It may be doubted whether as much attention is paid in England to the production of eggs as the utility of the food demands, and particularly by the poor, to whom their value is a consideration. Efforts should be made to induce all persons conveniently circumstanced to keep hens and ducks, and there is reason to believe that ducks are more profitable than hens, having regard to the number and size of the eggs laid by them. The solid matter and the oil in a duck's egg exceeds that of a hen's egg by as much as one fourth.

Eggs, their dietetic use apart, are of great utility in many branches of industry. In some, as in confectionery, both the whites and yolks are used, but usually the two find separate applications. The whites are employed in calico-printing, in photography, in gilding, in clarifying wines and liquors, and by the bookbinder on the leather previous to lettering or tooling.

An egg-oil is obtained in Russia in large quantities and of various qualities; the best so fine as to far excel olive-oil for cooking purposes. The less pure and very yellow qualities are chiefly used in the manufacture of the celebrated Kazan soap. Both of these products were shown at the London International Exhibition in 1862, and at subsequent exhibitions. Neither the oil for cooking purposes nor the soap are sufficiently cheap for general use; they are consumed only by the wealthy classes as luxuries; the soap, being regarded chiefly in the light of a cosmetic, is a much-valued addition to a Russian lady's toilet necessaries. The yolk is also used for medicinal purposes. It was used in the middle ages for the painter's art, before the discovery of oil-colors, as in the chapter-house at Westminster.

Eggs, whether to be used in culinary or pharmaceutical preparations, should be fresh. To determine this they should be examined by the light of a lamp. Fresh eggs are easily known by their transparency when held up to the light. By keeping they become cloudy, and when decidedly stale a distinct, dark, cloud-like appearance is discernible opposite some portion of the shell. Another simple mode is by placing the egg against the closed eyelid, and if the end of the egg is void it will feel warm, whereas if the egg is new laid it continues cold. A way to tell bad eggs is to put them in a pail of water, and, if good, they will lie on their sides; if bad, they will stand on their small ends, the large

end always uppermost, unless they have been shaken considerably, when they will stand either end up.

How to keep eggs is a problem that has attracted the attention of inquirers from the earliest times. Twenty or more processes are generally known, all of which give unsatisfactory and incomplete results—a circumstance scarcely to be wondered at when the composition of an egg and the various changes to which it is subjected by exposure to atmospheric influence are taken into consideration. The egg-shell is furnished with numerous pores, through which the water evaporates, the loss of aqueous contents thus sustained being scarcely perceptible in the first week, more marked in the second, and of considerable interest in the third. The surrounding atmospheric air takes the place of the water that has evaporated, and oxygenates the contents of the shell, which then commence to ferment and are speedily spoiled. To hinder this evaporation, and so aid the preservation of eggs, they are often steeped for twelve hours in lime-water, by which means molecules of lime are deposited on the shell, and so obstruct the pores to some extent.

To the solution of the problem of how to prevent the air from penetrating the shell of the egg, the experiments of such eminent *savants* as Musschenbroek, Réaumur, and Nollet have greatly contributed. They all agree that the most practicable method is to envelop the new-laid egg in a light coating of some impermeable substance, such as wax, tallow, oil, or a mixture of wax and olive-oil, or of olive-oil and tallow. Réaumur suggested an alcoholic solution of resin, or a thick solution of gelatin. Nollet experimented successfully with India-rubber, collodion, and various kinds of varnish. At the Dairy Products Show at the Agricultural Hall in 1884, three prizes were awarded for eggs preserved in the following manner:

1. Eggs which had been dipped twice in a solution of gum arabic and then dried, enveloped in paper, and kept in bran.

2. Eggs which had been rubbed with lard and then kept in dry salt.

3. Eggs coated with a composition of mutton and beef suet, and then wiped with a dry cloth.

With a view to utilizing in a more portable and consequently cheaper form the large supply of eggs obtainable in Austria, Messrs. Effner & Co. started a factory at Passau, in Bavaria, for condensing them. The eggs are carefully selected and dried, then reduced to a fine meal, and packed in tins ready for use. Although it is scarcely probable that the condensed egg can ever replace new-laid eggs for breakfast, it is asserted that a good omelet, as also the finest pastry, may be prepared from the product.

The eggs of wild birds are not very generally eaten in this country, but in some localities those of sea-fowl are largely consumed, and a considerable trade is carried on in gulls' eggs on many of our coasts. There is a great demand for plovers' eggs in the city markets for epicures. They are the eggs of the lapwing (*Vanellus cristatus*), a bird which lays about four eggs of an olive cast, spotted with black. These eggs come chiefly from Holland, the home produce being now very small, and they are received during the spring and summer, from March to June. Mr. Yarrell, who wrote many years ago, mentions that two hundred dozens of peewits' eggs were sent in one season from Romney Marsh to London. The eggs of many other species of birds are imposed upon the Londoners in the place of plovers' eggs.

In the sea islands of Alaska, the eggs of the thick-billed guillemot have an economic value, being the most palatable of all the varieties found in the islands, and hence are much sought after by the natives. The bird lays a single egg, large and very fancifully colored. The shell is so tough that, in gathering them, they are thrown into tubs and baskets on the cliffs, and poured out upon the rocks with a single flap of the hand, just as a sack of potatoes would be emptied, and only a trifling loss is sustained from broken or crushed eggs.

On the Faro Islands the number of eggs laid by the lesser black-backed gull, and sent annually to shore for culinary purposes, must be prodigious. The eggs of the common guillemot lie there so close together that it is difficult to move among them.

The eggs of the stork are very good eating, whether hot or cold. The natural color of the cormorant's egg seems to be a bluish green, like the usual variety of the common domestic duck, but over this is a thick, white, irregular covering of lime, which is frequently in such abundant quantity as to stand out in lumps on the surface, seldom allowing much of the original color to be visible. No doubt this superabundance of lime is produced by the bones of the fish, of which this bird is said to eat prodigious quantities, and perhaps also from shell-fish.

Turtles' eggs are held in great esteem wherever they are found, as well by Europeans as by others. They have a very soft shell, and are about the size of a pigeon's egg. The mother turtles lay three or four times a year, at intervals of two or three weeks. An experienced eye and hand are required to detect the eggs, as they are always ingeniously covered up with sand. The Orinoco and Amazon Indians obtain from these eggs a kind of clear, sweet oil, which they use instead of butter. In the month of February, when the high waters of the Orinoco have receded, millions of turtles come on shore to deposit their eggs. The certainty and abundance of the harvest is estimated by the acre. The yearly

gathering about the mouth of the river Amazon alone is some five thousand jars of oil, and it takes five thousand eggs to make a jar. The turtle comes at night, and deposits from one hundred and forty to two hundred white eggs in the sand, carefully covering them up before returning to the sea. In about fourteen days she returns again to the same place to lay, and will come up about four times before stopping laying, thus giving some six hundred to eight hundred eggs. A native of Brazil will consume as many as twenty or thirty turtles' eggs at a meal, and a European will eat a dozen at a breakfast. They make an excellent omelet. The Indians frequently eat them raw, mixed with their cassava flour. The condition in which the egg of the turtle is best fit to be eaten is when taken from the slain animal, before the formation of the glaze and the surrounding parchment-like skin, which answers the purpose of a shell.

The eggs of a large lizard (*Varanus vivitattus*) are eaten in Java. In the West Indies the eggs of the iguana are thought a delicacy. One of these lizards will sometimes contain as many as fourscore eggs, which, when boiled, are like marrow. They are about the size of a pigeon's egg, but with a soft shell. The eggs of the common teguexin (*Teius teguexin*), and of other large species of lizards, are eaten in South America.

In the Antilles and on the west coast of Africa the eggs of the alligator are eaten. They resemble in shape a hen's egg, and have much the same taste, but are larger. More than a hundred eggs have been found in one alligator.

The large eggs of the boa constrictor are regarded as a dainty by the Africans from the Congo. One of these snakes, killed on an estate in British Guiana in 1884, had fifty eggs, which were eaten by the negroes.

The eggs of various fishes differ remarkably in external appearance. Some would scarcely be believed to be eggs at all. Take, for instance, the skate's egg. It looks like a flattened leather purse, with four horns or handles at the corners. The yolk is in the shape of a walnut, larger or smaller according to the species. In the *Elasmobranchii*, sharks and rays, the ova are not so numerous as those of other fishes, the eggs being generally inclosed in coriaceous or leathery capsules, familiarly known to sea-side visitors as mermaids' purses and the like.

The egg of the picked dog-fish, the yolk of which is about the size of a pigeon's egg, is used by the inhabitants in parts of Sweden and Norway as a substitute for other eggs in their domestic economy. Cod-roe is sold in London in a dried form, smoked, and thus darkly colored. It is a delicious dish when partly salted, parboiled, and then fried. Cod-roes are exported in tins to Australia and India in the salted state. The late Frank Buckland examined

a cod-roe weighing seven pounds and three quarters, and found the average was one hundred and forty eggs to the grain. This gives 67,200 eggs to the ounce, so that in the whole mass of this one cod-roe, allowing three quarters of a pound for skin, membrane, etc., there were no less than 7,526,400 eggs.

*Caviare* is the common name for a preparation of the dried spawn or salted roe of fish. The black caviare is made from the roe of sturgeon, and a single large fish will sometimes yield as much as one hundred and twenty pounds of roe. A cheaper and less prized red kind is obtained from the roe of the gray mullet, and some of the carp species, which are common in the rivers and on the shores of the Black Sea. It is of interest to Turkey and the Levant trade only.

*Botargo* is a preparation made on the coasts of the Mediterranean, of the ovaries full of the mature eggs of the mullet (*Mugil cephalus*). The eggs are salted, crushed, reduced to a paste, and then dried in the sun. Sometimes spices or other ingredients are added. Botargo is eaten like caviare.

There is also a destruction by mankind of the ova or spawn of the *Crustacea*—lobsters, crabs, and shrimps—which are carried under their tail. The lobster produces from 25,000 to 40,000 eggs, the crayfish upward of 100,000. As much as six ounces of eggs can be taken off in May from a lobster weighing three to three pounds and a half, and there are about 6,720 eggs in an ounce of lobster spawn. The lobster is never so good as when in the condition of a "berried hen."

The eggs of some insects are eaten in Siam, Egypt, and Mexico, but those most valuable commercially are the eggs of the silk-moth.

The trade in silk-worms' eggs from Japan has become an extensive and profitable one. In 1868 £1,000,000 was paid to Japan by the "graineurs" of Europe for silk-worms' eggs. In 1869 two million cards, costing on an average 12*s.* 6*d.* each, were sent to Europe. In other years three millions of these cards, packed in cases of about three hundred, thickly studded with these tiny specks, have been shipped from Japan by the various steamers.

In China and Japan the moths are placed to lay their eggs on cardboard or thick paper, which they cover regularly and closely with a secretion which glues them to the spot and acts as a preservative from heat or other accidents. Hence the cards may be transported many thousands of miles safely, in a ship with a properly regulated temperature, so as to prevent their hatching too soon. They should be arranged, and the cards thickly covered, without being overlaid, and having no unpleasant smell. A first glance at one of these cards would lead one to suppose that the eggs were artificially attached to the card, but the regularity is

obtained by careful management of the moths at the time of laying the eggs. A vigorous moth will usually lay four or five hundred eggs. When the laying is terminated the peasants examine the cards, and, if there are any vacant places, attach a moth, by pins through its wings, so that the eggs may be deposited in the right place.—*Abridged from the Journal of the Society of Arts.*

## BOTANICAL GARDENS.

By Dr. FR. HOFFMANN.

NOTWITHSTANDING its size, prosperity, and luxury, the commercial metropolis of the United States has been hitherto a less fruitful soil for the rise and growth of humanistic and scientific institutions of learning, and museums, than Boston, Washington, Philadelphia, and, through its university, Baltimore. Movements, donations, and beginnings for the building up of such institutions have not been wanting, but they have usually been hindered by the predominance of mercantile interests and tendencies, unfortunate starts, misadministration, seizure by political aspirants, or lack of competent, skilled, unselfish management, and have fallen short of their intended and possible aims. Centenarian Columbia College, with its professional branch schools, has been left far behind by Harvard, Yale, and Johns Hopkins universities. The Astor and Lenox libraries can not compete with those of other cities of like importance with New York, and are surpassed by libraries in Boston and Washington. The Museum of Natural History in Central Park has only recently acquired importance and value; and the Art Museum has not till within a short time, by means of a few large bequests and gifts, overcome its previous failures. Ethnographical, zoölogical, botanical, and pharmacological museums are, except for the sporadic collections in scientific institutions, and for the ethnographic collection in the Historical Society, not existent, nor have we a botanical and zoölogical garden. The museums of the medical schools do not exceed the measure of demonstration objects, and the small pharmacological collection of the College of Pharmacy is one of the most neglected and insignificant of all.

The creation of higher institutions of learning and of scientific collections has hitherto been left for the most part to private enterprise and munificence; the latter has, as everywhere else in our country, accomplished much in New York that is good and useful, and has given large sums. But the givers have too often lacked correct understanding, and have failed to secure the qualified and experienced agents that were needed in order to put their rich

gifts to the best use. Men of the stamp of Louis Agassiz and Asa Gray do not readily grow up and flourish in the intellectual atmosphere of a commercial and partly political metropolis; or they are less appreciated; and therefore the endowers of large foundations want the stimulating and authoritative influence and the correct intelligence to apply their gifts in the right direction, and to guard them against extravagance from injudicious expenditure, dilettanteism, and experimenting. Furthermore, Americans, in their lack of knowledge and of models, have been distinguished by a tendency to perpetuate their munificence and names preferably in monumental edifices; hence the excessive foundation of so-called universities with splendid buildings, but which have been usually destitute of what alone, with or without architectural luxury, gives them purpose and value—an efficient faculty, well-endowed apparatuses, and capable pupils. In consequence of this erroneous comprehension and consequent expenditure in buildings, and by the scattering of teaching force and means, most of our higher schools, libraries, museums, and collections have been weakened. We have no lack of imposing structures, but no real universities and technical high-schools; libraries, like those of the Astor and Lenox in New York, elegantly housed without a correspondingly general value and utility. The munificence of our founders directs itself, as Prof. James M. Hart has remarked in his book on "German Universities," mainly to brick and mortar. The rest is left to chance and the discretion of the administration; hence numerous experiments, often followed by a miserable, inefficient career.

In comparison with other cities of like size and population, New York is poor in public squares and parks. In size and natural beauty the Central Park can indeed well sustain a comparison with the parks of other cities, and it might, if the money poured out upon it since its creation in 1857 had been wisely and honestly expended, have been one of the best parks and botanical gardens in the world. If Nature had not done so much for it, it would stand, notwithstanding half a million dollars a year are expended upon it, far behind the parks of other great cities. If only a part of this sum had been systematically applied to the maintenance of a competent, experienced botanical and landscape gardener as director of the plantations, and the necessary palm- and plant-houses had been erected, the Central Park might have been, not only one of the largest but one of the handsomest public parks and botanical gardens; for, with its superficies of eight hundred and forty acres, it has a much greater area than, for example, Regent's Park, with its beautiful botanical and zoölogical gardens, Kensington Garden, and the Kew Gardens of London, taken together. The last-named, a famous botanical garden, contains

only sixty-seven acres, and has nothing like the diversity of formation that the Central Park contains.

The plan for making Central Park, like those parks, a botanical garden as well, has existed since its foundation in 1857,* and has come up again from time to time; a costly beginning was projected under the Tweed *régime*, and the foundations were laid for a large glass house, by which the little lake on the east side of the park between Seventy-third and Seventy-fourth Streets was to be roofed for the cultivation of *Victoria regia* and other fresh-water plants. The money that was appropriated found takers enough, but no building came out of it.

Much might be accomplished in the Central Park with its rich flora under expert and artistic administration, without great cost, if only the majority of the trees and shrubs were marked with their botanical and English names, as is done in the squares of Philadelphia, Boston, and other cities; and the people of the city might thus be put in the way of becoming acquainted with at least the native trees and bushes, and excited to some interest in botany. The daily thousands of summer visitors pass by these abundant groups of plants without any information to their names, and without any means or motive for informing themselves respecting these objects that make the park attractive and beautiful. This, however, is one of the most important purposes of the botanical gardens of our time; and the Central Park could fulfill it as well as and even better than Regent's Park and Kensington Garden and the plant-houses in Hyde Park in London.

Of the eight hundred and forty acres in the Central Park, four

* It may be of interest to mention here that after the once famous Hamilton Garden near Philadelphia, which was managed for three years toward the end of the last century by the famous botanist, Friedrich Pursh, New York has had the first botanical garden in North America. It was established in 1801 by Dr. David Hosack, a physician, who came to this country from Scotland, on a tract of about twenty acres, which he bought from the city. It was situated several miles north of the city at the time, on the place of the present square between Fifth and Sixth Avenues and Forty-sixth and Forty-seventh Streets. The wooded, hilly land was cleared and laid out and surrounded by a stone wall, along which the tall forest-trees were allowed to remain. In 1805 the garden was under high cultivation, and contained over fifteen hundred species of American useful, medicinal, and ornamental plants, a good hot-house, and an audience-room for botanical teaching. In 1806 and 1807 two hot-houses were added, and a number of West Indian and European plants were put under cultivation. A catalogue printed in 1807 gave the names of two thousand species. The garden—which Dr. Hosack had named the Elgin Garden, after his Scottish home—was regularly taken care of during the following years by the owner and some wealthy lovers of plants; but was sold in 1810, for want of means to carry it on, to the State of New York, for seventy-three thousand dollars. With this, skillful direction of the garden seems to have come to an end. It was committed in turn to the Regents of the University of New York, the faculty of the College of Physicians and Surgeons, and finally to Columbia College. This wealthy corporation, by an arrangement with the State Legislature in 1816, annexed the garden, which had fallen into decay, and with this the once widely known Elgin Botanical Garden, of New York, ceased to be.

hundred acres are wooded with trees and shrubs; forty-three and a quarter acres, besides the reservoirs, are covered with water in the six lakes; and of the many meadows the largest contains nineteen acres. The size, conditions of soil, natural beauty, and central location are therefore far more favorable and more diversified than in the famous parks and botanical gardens of London, Paris, and Berlin. Only a proper beginning, a scientific and artistic organization, and the wise application of the means that are at hand, are needed to combine the useful with the agreeable in the park, and make it also one of the handsomest of botanical gardens.

One is therefore involuntarily reminded of Schiller's words—

"Warum in die Ferne schweifen, sieh' das Gute liegt so nah?"

("Why wander into the far, seeing the good lies so near?") when he regards the present movement and efforts to create a "great botanical garden" in certain territory in the northern annex to the city, on the Bronx River, beyond Mount Vernon. A committee of the Torrey Botanical Club is trying and hopes to collect a million dollars for that purpose. It is given among the purposes to be attained by this garden that it will furnish the city with living plants as demonstration objects for botanical instruction in the medicinal, pharmaceutical, and other institutions. But smaller gardens and houses for the cultivation of tender and half-hardy plants, like the little botanical garden created by Prof. Asa Gray and his pupils in Cambridge, the Arboretum in Boston, and Shaw's Gardens in St. Louis, would be abundantly sufficient for this purpose. Instead of utilizing that which is at hand and near us, we must, in a fashion characteristic of New York, have something new and grand for a botanical garden—a scheme that will bring money among the people, give position and name to politicians, feed the mills of land-speculators and contractors, and therefore find favor everywhere.

The project is not objectionable in itself. But why not apply it to the already existing Central Park, which has abundant room and all that is needed for the establishment of a complete botanical garden, and would gain immensely by it in usefulness and beauty? With a million dollars all could be provided on the same grand scale that the Kew Garden of London possesses in plantations, hot-houses, and botanical museums; moreover, a large sum of money alone will no more make a great botanical garden than it will a great university. It requires, first of all, the intellectual creators and the scientifically and artistically competent organizers and architects.

Without reverting in this short article to the history of botanical gardens, which may be found in every large encyclopædia, we will confine ourselves to the discussion of their scientific importance. This is not so much in the drift of modern botanical sci-

ences than it was formerly. With the popularization of science and the rise of landscape gardening on an extensive scale in or near all the great cities, botanical gardens have acquired more and more importance and perhaps greater value for the awakening and instruction of the masses, and should therefore be made easily accessible to them and as instructive as possible. Hence the public parks that are most easily within reach of the largest numbers of people are the peculiarly favorable territory on which to place botanical gardens. Their importance and usefulness in this sense were recently expounded in a striking manner by Prof. Schwendener in his address on assuming the rectorate of the University of Berlin, when, having described the present condition of botany and its aims and purposes, he said: "If we ask how botanical gardens stand in reference to this new direction, it can not be denied that they are in general behind the progress of science. They still exhibit, aside from a few unimportant changes, the impress of an earlier time. Certain fashionable plants, like palms, orchids, camellias, azalias, cactuses, heaths, etc., are cultivated in extravagant numbers, and grow, bloom, and decay without bearing any fruit for science. Where there are specialists, who work up some group in monographs, as rich a representation of its forms in living examples as possible may be justified; but we should not forget in this case that most systematic research must rest for the greater part on herbarium material, for the whole number of cultivated forms constitute only a fraction of what is already described. The largest collections of living plants in the gardens of the great cities may contain sixteen thousand or eighteen thousand species; but the flora of the whole earth includes ten times as many. The phytographer is not willing to depend upon garden specimens, because they sometimes vary considerably from plants collected in nature and afford no certain guarantees of their origin. It is therefore not to be supposed that the demands of the new system can be satisfied with specimens that have grown under cultivation. Hardly anything else can be expected of the future than that the enormous stock of living plants which all the great gardens now exhibit will suffer a gradual reduction.

"But if the vegetable kingdom is gradually giving up the charm which it has exercised so long, what shall take its place? The gardens as such stand in no other relation to the now dominant microscopical and experimental physiological research than that of furnishing the necessary material and a certain number of plants for experiment, and for that no particular efforts or large gardens are needed. In this direction, therefore, no one will probably desire extensive enterprises or set up new aims.

"As little does it lie in the province of botanical gardens to deal with problems in the geography of plants. What has hith-

erto been done in this direction by the arrangement of geographical groups, and which is all that can be done in the future, belongs to the domain of popular demonstration and the instruction of wider circles, not to that of science. It may be of real interest to the garden-visiting public to find Japanese, Chinese, American, or Australian plants, etc., together in greater numbers, and the administration of the gardens are not to be blamed if they meet this popular desire as practically as they can, only they must not conceive that they are thereby solving any scientific problem.

"The one thing that remains for the directors of botanical gardens, if they would keep up with the progress of science and to make them something more than mere magazines of living plants, is to engage themselves in the questions that concern the variability of organic forms, the influence of changed life-conditions on the form, the phenomena of hybridization and reversion, and especially the factors that are conducive to the further development of the vegetable kingdom and of its history.

"If we raise the question, in conclusion, of what will be the consequences of the perspective we have defined for the botanical gardens, it is hardly to be feared for the smaller gardens, serving principally for the purposes of instruction, that they will be seriously affected by it, for their stock of plants does not at most exceed the present requirements for demonstration.

"But a profounder change concerning the scientific side of botanical gardens may nevertheless be anticipated in the future. The fashionable plants of the trade-gardens and the monotonous forms of certain genera which require whole houses in their aimless fullness of species do not deserve such a preference; and the time is at hand for botanical gardens to break with these old traditions and to carry out a stricter selection connected with necessary reforms in nomenclature. For this is demanded an expert and energetic administration which recognizes modern problems and knows how to overcome the hindrances that stand in the way."

What evidently is wanted and should be created in New York is what the botanical gardens of London, Paris, Berlin, and other great cities principally are, a "magazine" of cultivated native and exotic plants, in which botanists and lovers of plants as well as the masses can enjoy themselves and be instructed, and by means of which a perception of and interest in the beauty and endless richness of forms and colors of the plant-world can be awakened and advanced in the populace. The Central Park is eminently adapted for such an establishment, has the right location for it, abundant space, and therefore all the prerequisites that are needed. Should it seem desirable, in the course of the growth of the city northward, at some later time to have more and new

parks with botanical gardens, future generations will know how to provide them, probably with better means and service, and in any case with closer-lying interest and benefit. At present it would be an extravagance, a vain illusion, and a needless and costly experiment, to go for the establishment of a botanical garden beyond the Central Park, which is so well adapted to the purpose, and to create from the beginning a "grand botanical garden" at a considerable distance in a wholly unprepared territory. —*Translated and abridged for the Popular Science Monthly from the March number of Pharmaceutische Rundschau.*

## THE DESERT OF GOBI AND THE HIMALAYAS.

By Lieutenant F. E. YOUNGHUSBAND.*

THE Royal Geographical Society enjoyed a profitable evening a few months ago in hearing an account by Lieutenant F. E. Younghusband of a journey which he had made across Central Asia from Manchuria and Peking to Kashmir, over the Mustagh Pass, and the discussion upon it, in which officers learned in Indian geography took part. The author started in the summer of 1885, with Mr. H. E. M. James, who has since published in the book called "The Long White Mountain" the best account of Manchuria that we have. The travelers separated, after a pleasant and profitable journey, at Newchang, Mr. James to return home by way of Chifu and America, and Lieutenant Younghusband to travel back to India through Mongolia and Chinese Turkistan.

Respecting the field of the earlier journey, the author asserts that "few countries could repay the traveler better for his labors than Manchuria. It is a noble country, and well worthy of being the birthplace of the successive dynasties which issuing from it have conquered all the countries round, and of that dynasty which to-day holds sway over the most populous empire in the world. The fertility of the soil is extraordinary; the plain country is richly cultivated and dotted over with flourishing villages and thriving market towns, and the hills are covered with magnificent forests of oak and elm. The mineral resources are at present undeveloped, but coal and iron, gold and silver are known to be procurable. The climate is healthy and invigorating, but very cold in winter, when the temperature varies from 10° below zero Fahr. in the south to 40° or more below zero in the north. Rivers are numerous and large." The principal river is the Sun-

* Condensed from the author's paper in the "Proceedings of the Royal Geographical Society."

gari, which is navigable for vessels of three or four feet draught as far as Kirin, and whose rich valley is every year attracting thousands of colonists from China. The drawback is brigandage, which is very rife in northern Manchuria, and on account of which the people have to collect, for their own protection, in large villages and towns, so that small hamlets and detached farm-houses are never seen. Though it is Manchuria, the country is not inhabited by Manchus. They have been drained off to China proper, and their places are taken by immigrants from the Chinese provinces. The people of the original race have lost their old warlike spirit, and are a laughing-stock to the Chinese colonists. Unable to make headway against the brigands, they depend on the Chinese regiments to do that work for them.

A great many things had to be thought of in preparing for a long journey over an almost unknown country, in which were included the crossing of the terrible Desert of Gobi and of the Himalaya Mountains. Bills could not be obtained on any town in Turkistan, and it was necessary to carry money in bulk. If the Chinese copper coinage were taken, it would require a train of mules to carry a sufficient sum. The problem was solved by taking sixty pounds of solid silver, stowed away in the baggage. Clothing must be provided in anticipation both of great heat and of intense cold; and medicines had to be laid in, for the people as well as for the traveler and his party, "for they are always useful for giving to the natives. It is well I did so, for Mr. Dalgleisch's fame as a medicine-man had spread throughout Turkistan, and the Turkis thought that I, being also English, must be able to cure them instantly of any illness they had."

Ascending the valley of the Yangho from Kalgan, "the country presented a desolate and deserted appearance, for the villages were half in ruins; numerous watch-towers, now falling in pieces, were scattered over the country; and the inhabitants, looking ill-fed and badly clothed, were attempting in a half-hearted way to cultivate fields which were constantly being covered with layers of dust by the horrible sand-storms that used to occur almost daily at this time of the year. The country is of the formation called loess—a light, friable soil which crumbles to dust when the slightest pressure is put upon it. In consequence of this the roads are sunk thirty to forty feet below the level of the surrounding country; for when a cart passes along a road the soil crumbles into dust, the wind blows the dust away, and a rut is formed. More traffic follows, more dust is blown away, and gradually the roadway sinks lower and lower below the surrounding level; for the Chinese here, as elsewhere, never think of repairing a road. . . . On the 14th of April, 1886, I emerged on to the real steppes which are the characteristic features of Mongolia proper. Stretch-

ing far away in the distance there was a great, rolling, grassy plain, on which the flocks and herds and the *yurtas*, or felt tents, of the Mongols were scattered about. These people offered a striking contrast to the Chinese inhabiting the districts I had just left. They were strong and robust, with round, ruddy faces, very simple-minded, and full of hearty good humor. They are entirely pastoral and nomadic in their habits, and do not take to agricultural pursuits. The old warlike spirit which made them so powerful in the days of Genghis Khan has now disappeared completely. The Chinese Government has purposely encouraged the men to become Lamas, and now it is said that as many as sixty per cent of the whole male population are Lamas, who, by their religion, are neither allowed to marry nor to fight. In consequence, there is a great decrease in the fighting strength of the Mongols, as well as in the whole population. A recent famine carried away numbers more, and the country, it seems, would almost become depopulated were it not that Chinese immigrants are now invading it, and these are even outdoing the Mongols in their own callings, for I met Chinese in Mongolia who owned flocks of sheep which they were fattening for the Peking market."

In order to avoid the heat of the day, and to let the camels feed by daylight, when they could be watched and kept from straying, the usual plan of the journey was to start at about three o'clock in the afternoon, and travel on till midnight or later. The nights were often extremely beautiful, and the stars shone out with an unwonted magnificence. "Venus was a resplendent object, and guided us over many a mile of that desert. The Milky Way, too, was so bright that it looked like a bright phosphorescent cloud, or as a cloud with the moon behind it. This clearness of the atmosphere was probably due to its being so remarkably dry. Everything became parched up and so charged with electricity that in opening out a sheep-skin coat or a blanket a loud crackling noise would be given out, accompanied by a sheet of fire. The temperature used to vary considerably. Frosts continued to the end of May, but the days were often very hot, and were frequently hottest at nine or ten in the morning, for later on a strong wind would usually spring up, blowing sometimes with extreme violence, up till sunset, when it generally subsided again. If this wind was from the north, the weather was fine but cold. If it was from the south, it would be warmer, but clouds would collect, and rain would sometimes fall; generally, however, the rain would pass off into steam before reaching the ground. Ahead of us we could see the rain falling heavily, but before it reached the ground it would gradually disappear—vanish away—and when we reached the spot over which the rain had been falling there would not be a sign of moisture on the ground." Instead of the rain, the sand

found its way everywhere. Occasionally the march had to be given up because the camels could not make head against the violence of the wind.

A great ridge of bare sand, destitute of vegetation, at the western end of the Husku Hills, about forty miles long and nine hundred feet high, is associated with a tradition of a large military force having once been collected and preparing to march to China, when a mighty wind arose, blowing the sand against them and burying them all, together with several villages and temples.

The Altai Mountains are perfectly barren, with the upper portion composed of bare rock and the lower of long gravel slopes, formed of the *débris* of the rocks above. This *débris* is formed under the influence of the extremes of the climate upon the unprotected rock, with no rainfall sufficient to wash it away. So it accumulates in a uniform slope, often thirty or forty miles in length, leaving only a few hundred feet of the original jaggy outline of the mountain visible at the top. A prominent Altai peak was pointed out to the traveler as covering a grassy hollow which is frequented by wild camels. The Mongols are said to shoot these animals for the sake of their skins, and also to catch the young ones and train them to be ridden. They will go two hundred miles a day for a week, but can not be broken to carry a load. They are smaller than the tame camels, and are said to have short, smooth hair, in place of the long hair of the ordinary Mongolian camel. Considerable numbers of wild asses, and wild horses, the *Equus Prejevalski*, were seen roaming around the plains.

The most trying march in the desert was that of the last day, which was performed in sight of the Tian Shan, or "Heavenly Mountains." It was seventy miles in length, "and not a sign of water could be found throughout, while the heat was intense, for the wind blew off the heated gravel as from a furnace, and I used to hold up my hand to protect my face from it, in the same way as one would in front of a fire." On the next evening a friendly voice welcomed the party as it was ascending the lower slopes of the Tian Shan to a Turki house, with a stream of water running by it. The country on the southern slope of the range still continued desert, but with a small oasis every fifteen or twenty miles, containing a village and cultivated lands. A difference was at once observed between the Turki and ordinary Chinese towns. "In China the houses are, as a rule, large and well built, with pent roofs and overhanging eaves. The shops are of a respectable size, with plenty of room inside for the storage of goods for sale, and for several bustling shopkeepers, who serve their customers from behind good solid counters. In Turkistan the houses and shops are more after the Indian style. They are built of mud, low, and flat-roofed, and the shops small and heaped up all round with goods,

so that there is little room left for the shopkeeper. . . . If you could get a bird's-eye view of Chinese Turkistan, you would see a great, bare desert, surrounded on three sides by barren mountains, and at their bases you would see some vivid green spots, showing out sharp and distinct, like blots of green paint dropped on to a sepia picture." The oases are extraordinarily fertile; every scrap of land that can be cultivated is used up, and every drop of water is drained off and used for irrigation. The inhabitants are industrious, but not so good cultivators as the Chinese. They seem peaceful and contented, dress simply and well, and live in houses which, though built of mud, are kept remarkably clean inside. They are, however, much lacking in spirit, and stand in great awe of the Chinese, who produce upon them, as well as upon all the people of these regions, an impression of their overwhelming strength and importance. They are perfect masters of the art of impressing Orientals; their officials are scarcely known as human beings, but "are presences inhabiting a great walled-in inclosure, entrance to which is barred by massive gates, and they never appear in public except in state and accompanied by an escort. China, too, is regarded by the Turkis as an almost fabulous country." They never go there, and "only hear of it from the Chinese, who give the most exaggerated descriptions of it, telling them that the emperor has an untold number of soldiers at his command, and has a hill of gold and a hill of silver, from which he obtains inexhaustible wealth." Turfan, being seated at a very low elevation and surrounded by the desert, suffers from an intense heat, and the people, to avoid it, dig underground rooms, and live in them during the day.

The Kirghiz, whose country came next in order, were found more well-to-do than the Mongols or Kalmucs, dressing better, living in better tents, and keeping them clean; fine, strong men, not so industrious as the Turkis, but a great deal more so than the Mongols. "We put up every night in their tents, and they were generally very civil, though naturally rather curious to know who I was and see all my things. The Afghan had a hard time answering all the questions, so, when he found it monotonous, he used to spread a rug and solemnly say his prayers. He was a Hadji, and, to keep up his religion properly, had to pray five times a day. When he had been traveling all day, and had not been able to say his prayers, he used to make up for it in the evening by repeating them once every half-hour or so." On the plain called the Syrt were large fields of wheat grown by the Kirghiz, who had built houses to store their grain in, but continued to live themselves in their tents. "They said they preferred not living in houses, as they were always afraid of their tumbling down upon them." The author himself, when crossing the Himalayas

a few days afterward, had to guard against the dangers of living in a tent. In that region the Kanjutis are on the watch for the traveler, and, learning his ways in the day, attack him at night. If he pitches a tent, they cut the ropes and catch him inside it. "So, as I wished to end my journey in India, and not in Kanjut, I gave up using a tent, and for three weeks, while crossing the Himalayas, bivouacked out, spreading my rugs on the ground on the least windy side of any friendly rock I could find, and always changing my position after dark."

A complete outfit had to be procured for crossing the lofty range—good, sound, hard ponies, spare shoes for them, and tools for shoeing them; pack-saddles and blankets, and long sheep-skin coats for the men, and, as there would be no paths, pick-axes and spades for road-making. "As we got further into the mountains, I noticed that the heavy haze which perpetually hangs over the Kashgar and Yarkand districts faded away. This haze must, I think, be formed of dust stirred up by the strong winds which blow almost daily in those districts, for I noticed that there was a thin, permanent coating of dust on the rocks in the valley of the Tisuaf River, where there is practically no natural dust, but over which this haze continually hangs, and that, as we advanced inland and the haze disappeared, so also did this coating of dust on the rocks."

From the summit of the Aghil Darvan Pass (sixteen thousand or seventeen thousand feet high) the author had a view of the great Mustagh Range, or Karakorum Mountains, which form the water-shed between the rivers that flow into the Indian Ocean and those which take their way toward central Asia, with an immense glacier flowing down from the main range. "The appearance of these mountains is extremely bold and rugged as they rise in succession of needle peaks, like hundreds of Matterhorns collected together; but the Matterhorn, Mont Blanc, and all the Swiss mountains would have been several hundred feet below me, while these mountains rose up in solemn grandeur thousands of feet above me. Not a living thing was seen and not a sound was heard; all was snow and ice and rocky precipices, while these mountains are far too grand to support anything so insignificant as trees or vegetation of any sort. They stand bold and solitary in their glory, and only permit man to come among them for a few months in the year, that he may admire their magnificence and go tell it to his comrades in the world beneath. As I looked on the scene, I felt as if I were intruding on the abode of some great, invisible, but all-pervading deity."

After ascending the Sarpo Laggo River for a few miles toward the Mustagh Pass, "we came in view of the great peak K2, the second highest mountain in the world, 28,250 feet in height. We

could see it through a break in the mountains, rising up straight, bold, and solitary, covered from foot to summit with perpetual snow. The upper part, for perhaps five thousand feet, was a perfect cone, and seems to be composed entirely of ice and snow, the accumulation of ages. The lower part was more precipitous, but steep enough to throw off the snow altogether, while at the base was a great glacier formed by the masses of snow which fell from its sides. It was a magnificent sight, and I could scarcely tear myself away from it." The name K2 has been given to this mountain by the Trigonometrical Survey, waiting the discovery of a native name for it, for this enlightened corps always prefers native names when they can be found. Probably, however, like Mount Everest,* it has no name, not being familiar enough to the people to receive one, for both summits can be seen only from almost inaccessible places. The name Peak Godwin-Austen, after the officer who first surveyed the Mustagh Range and glaciers, was proposed for it at this meeting of the Royal Geographical Society.

The thrilling description of the crossing of the Mustagh Pass, where the party reached the height of nineteen thousand feet above the sea, is too long to be quoted here. It simply includes the usual adventures of icy Alpine climbing intensified, and adds no new facts. General Strachey, President of the Geographical Society, remarked, in the discussion of Lieutenant Younghusband's paper, that this pass appeared to be the center of the most wonderful accumulation of glaciers on the face of the earth. Some of them, which Colonel Godwin-Austen described, and which Lieutenant Younghusband must have passed over, were from thirty to forty miles in length, and probably, by passing from one to another, the traveler should be able to go over a glacier surface of seventy or eighty miles.

## SKETCH OF RUDOLF CLAUSIUS.

THE name of Prof. Clausius—"one of the most brilliant lights of the nineteenth century," as he is called by one of the Vice-Presidents of the British Association—is conspicuously associated, along with those of Rankine and Prof. William Thomson, in the development of the science of thermodynamics, or the demonstration of the mechanical theory of heat; and to him is credited the first placing of the kinetic theory of gases on a secure scientific basis. England and France mourned almost equally with Germany in his death—England, because of his association with the great British

* The name commonly given as the native name of Mount Everest is not the name of the pinnacle itself, but of one of the satellite peaks by which it is surrounded, and which shut it off from ordinary view.

students of the nature of heat; and France, because he completed a work begun by her own Sadi Carnot, and because of a sentimental affection to which she had already given a unique expression.

RUDOLF JULIUS EMANUEL CLAUSIUS was born in Cöslin, Pomerania, January 12, 1822, and died in Bonn, August 24, 1888. He began his course of studies at the gymnasium in Stettin, where he made such marked progress as to attract the attention of his teachers and secure for him an early transfer to the University of Berlin. Here he evinced a predominant taste for the mathematical branches. He afterward went to the University of Halle, and received its doctor's degree in 1848. He then won the position of a *Privat Docent* at the University of Berlin, and a few months afterward was appointed Instructor of Natural Philosophy in the School of Artillery. At about this time he began his contributions of scientific papers to Poggendorff's "Annalen," some of the earliest of which were selected for translation in the first volume of Taylor's "Scientific Memoirs." In 1857 he was appointed by the Swiss Federal Government Professor of Natural Philosophy in the Polytechnic School at Zurich. His career at this place was distinguished by continued activity in his favorite fields of research, besides which "he published some short papers on some purely mathematical questions, suggested, however, by physical problems, and some papers dealing with what is generally known as physical chemistry." He gave up his chair in Zurich in 1867 to go to a similar position in Wurzburg, whence two years afterward he removed to become Professor of Natural Philosophy in the University of Bonn. He became dean of this institution in 1874, and continued there till his death.

The memoirs published by Clausius are estimated to number more than a hundred. Seventy-seven are recorded on the lists of the Royal Society up to 1873. Among his earlier papers the most famous are those "On the Nature of those Constituents of the Atmosphere by which the Reflection of the Light within it is effected," and "On the Blue Color of the Sky, and on the Morning and the Evening Red," which were published while he was in his tutorship at Berlin. While at Zurich he published "The Influence of Pressure on the Freezing-Point"; "The Mechanical Equivalent of an Electric Discharge, and the Heating of the Conducting Wire which accompanies it"; "Electrical Conduction in Electrolytes"; and "The Effect of Temperature on Electric Conductivity." In 1866 he published an important paper "On the Determination of the Energy and Entropy of a Body," in which a very valuable and suggestive conception was set forth. The idea of entropy, by which term is designated the available energy of a system, or that which can be converted into mechanical work, which he first conceived in 1854, and which led him to some extremely general and bold

conclusions concerning the universe, was developed and extended in his address before the Congress of German Physicians and Naturalists at Frankfort in 1867, eliciting the principle that the entropy of the universe tends toward a maximum.

The principal works of Clausius, on which his chief title to fame must rest, are those on "The Potential Function and the Potential" (1857), and on "The Mechanical Theory of Heat," the first volume of which was puhlished in 1864. The properties of the potential function, while they had been neglected for a considerable time in France, had been put to their best use by all the philosophers of Germany and England who had treated of the natural forces of attraction and repulsion—particularly by such students as Gauss, Kirchhoff, and Thomson. In the preface to the second edition of his work on this subject, Prof. Clausius made the modest declaration that it was not his aim to institute new researches on the fundamental properties of the function, but simply to expound an existing theory. But it is evident through the treatise, as M. P. Langlois has shown, that while he takes up the ideas of Green and Gauss, he makes them his own by the simplifications which he has brought to them on one side and the extension which he has on the other hand given to some parts of the research. The work is distinguished beyond all other things, M. Langlois adds, by the strength of the analytic faculty displayed in it, which is carried to its ultimate limit. "Not contented with having established a formula, Clausius knew how to make it of remarkable utility. Two fundamental and particular ideas are developed in the treatise. First, the author fixes with precision the difference between the potential function and the potential, and shows the exact significance that should be given to the two, which are so much used in mathematical physics, and especially now in questions of electric dynamics; and he elucidates alike the idea of the potential of a mass upon itself and restores to the potential its true value, which had been erroneously doubled. . . . But it is not to this work that Clausius is indebted for his legitimate fame. His name is pre-eminently attached to the great problem of thermodynamics; and it is in his studies in this branch that his influence has made itself predominantly felt."

Thermodynamics may be said to date from 1824, when Sadi Carnot published his "Reflections on the Motor Power of Fire and on Machines suitable for developing it." The question of the nature of heat had already occupied Rumford and Davy, to say nothing of Bacon and Stahl; and being a dominating one in the problems into which it entered, arrested all physicists, who had only one step more to make to create thermodynamics. Carnot introduced the idea of mechanical work into the study, and sought to fix the relation that exists between the work of a thermic machine and

the heat which it employs. Waiving the too subtile question of the nature of heat, he devoted himself principally to fixing the conditions under which a maximum of work is yielded with a given quantity of heat. Guided by the purely philosophical idea of the equivalence of the work expended and the work produced, in perfect mechanics, he affirmed the analogous principle that the possible work is proportional to the quantity of heat employed and to certain functions of the temperatures of the vapor on coming in and going out. Carnot's annunciation of his theory was defective in that it took no notice of the fact that the hot body gives out more heat than the cold one receives from it, and that it regarded as equal the amount of heat received upon one isothermal side of a cycle and that emitted from the other side; a principle that may hold good for infinitely small cycles, but not for larger ones, in which a difference exists between the thermic quantities proportioned to the size of the cycle. This error and the true condition as pointed out by Clausius are defined by Prof. Rankine, who says, in his paper "On the Economy of Heat in Expansive Machines": "Carnot was the first to assert the law that the ratio of the maximum mechanical effect to the whole heat expended in an expansive machine is a function solely of the two temperatures at which the heat is respectively received and emitted, and is independent of the nature of the working substance. But his investigations, not being based on the principle of the dynamic convertibility of heat, involve the fallacy that power can be produced out of nothing. The merit of combining Carnot's law, as it is termed, with that of the convertibility of heat and power, belongs to Mr. Clausius and Prof. William Thomson; and, in the shape in which they have brought it, it may be stated thus: The maximum proportion of heat converted into expansive power by any machine is a function solely of the temperatures at which heat is received and emitted by the working substance, which function for each pair of temperatures is the same for all substances in nature." The law as thus modified and newly expressed might, as M. Langlois remarks, be designated as the equation of Clausius. But Clausius himself, acknowledging the influence which the Frenchman's ideas had exercised upon him, called it the theorem of Carnot. The second volume of the "Mechanical Theory of Heat" is almost wholly devoted to applications to electrical phenomena.

The reviewer in "Nature" of the English translation of this work says that the method of treatment pursued in it left hardly anything to be desired, "even from the point of view of a student previously ignorant of the subject. The reader is nowhere perplexed by uncouth symbols or analytical operations beyond those which are familiar to all acquainted with the principles of the differential and integral calculus. At the same time, . . . the reader is

never allowed to lose sight of the essential meaning of the symbols employed. . . . Any one wishing to gain a general acquaintance, thorough as far as it goes, with the subject, can scarcely do so with the expenditure of less time and labor than are required for the perusal of this book. As a mathematical study the book may replace some of the luxuriant growths of modern geometry and analysis with great advantage to the brains of the student."

In his later years Clausius was interested principally in the study of the questions raised by dynamo-electric machines. He published a theory of dynamo-motors in "La Lumière électrique," in 1884, in which he sought to fix more general equations, resting on more solid theories than those in use; but, notwithstanding his memoir is marked by his peculiar qualities, the theories have not been accepted, and have only been partly, if at all, confirmed by late researches. Yet it is to him that we owe a brilliant and clear exposition, and one of the first that was made, of certain phenomena of self-induction.

The Franco-German War occurred while Prof. Clausius was at Bonn. Although he was not liable to draft in the general mobilization, he was engaged in the ambulance service, and diligently interested himself in the care of the wounded. After the war was over, the German Government decorated him with the order of the Iron Cross, and the French with that of the Legion of Honor. The reason of the French awarding such a distinction upon an eminent German at such a time, when resentments still lively enough were at their height, is most probably to be found in the fact that he did not observe distinctions of nationality in his attentions. The incident affords a striking illustration of the effect of scientific studies in widening the range of thought and sympathy.

Prof. Clausius is described by M. Langlois as having been a teacher of remarkable clearness and simplicity in his explanations. His instruction was marked by a particular care to keep always within the limits of true physical principles. While he was remarkably versed in mathematical methods, he always kept the physical notations in the minds of his readers, and never allowed himself to be carried by his analyses into the regions of too vague conceptions. Mr. G. W. de Tunzelmann agrees with this conclusion in his obituary sketch in "Nature," saying that Clausius formed a center of attraction at Bonn, "not only as a great investigator, but as a teacher of almost unrivaled ability. The secret of his powers as a teacher may easily be guessed from the study of his published papers and treatises." The greater part of his work, the writer adds, had the additional advantage of being effected by the aid of comparatively simple analysis.

Prof. Clausius was elected a foreign member of the Royal Society in 1868, and received its Copley medal in 1879.

# CORRESPONDENCE.

## "PLAYING 'POSSUM."

*Editor Popular Science Monthly:*

IN your February issue Mr. S. F. Goodrich brings up the question whether animals ever "play 'possum." He suggests that the apparent helplessness of certain animals when attacked is real; that what is popularly ascribed to cunning is in reality due to fright—a *faint*, and not a *feint*.

This theory is new to the great majority of those who have observed the habit referred to; but its newness is not of itself a serious objection to it. Many familiar phenomena have waited long before receiving correct explanation. It has always been taken for granted that animals passive in the presence of danger were attempting deception. Rarely has any other explanation of their conduct been offered; but it does seem almost incredible that our far-away kinfolk should be using that distinctively human device—simulation.

Many of these acts can be satisfactorily explained on either assumption. The opossum may at times be unable to move because of his fright, or he may assume the passiveness of death as his surest hope for life. Which appears the more reasonable? Granted that it is difficult for us to credit the animals in question with sufficient intelligence and self-control to select deliberately such mode of defense, does not the other theory involve us in much greater difficulties?

Do the lower animals ever feign any condition? If this question can be answered positively, it seems to me that we shall have the solution to the other problem. The cat, when playing with a captured mouse, *appears* to feign unconcern and forgetfulness while looking away from its victim, and surprise on seeing it again. Probably there are very few persons who have not at least once been deceived by the disabled appearance of birds when their nests or young were approached. Very many of our birds under these circumstances act so as to draw attention to themselves, and when pursued keep just out of reach, luring the pursuer to his greatest efforts by seeming to have reached the maximum of their speed. Finally, the foolish one, with feelings injured, gives up the chase in disgust. Are the birds conscious that their appearance is deceptive? Fear certainly did not make them really helpless. If it be admitted that there is hypocrisy in such cases, then it may not seem impossible for even these stupid animals to feign other conditions, not excepting that of death.

If the opossum while in this passive state be thrown into water, its passiveness will be modified somewhat, but will still be maintained. Its nose will be kept above the surface, and it will paddle away so very gently that the motion is hard to detect. If while "dead" a stick be put into its open mouth, it will quietly close on it with its teeth, and may then be carried long distances swinging from the stick, but showing no other signs of consciousness; or it may be carried by the tail, it doing the holding. Do these facts, which none acquainted with the habits of opossums will question, sustain the theory of paralyzing fear?

The fox also appears helpless sometimes when caught, and there are instances recorded of men being severely bitten because of too much faith in its apparent innocence.

The toad when captured frequently makes a complete surrender, closing its eyes and settling down to apparent listlessness. If everything remains quiet, its eyes will soon open very gradually, closing again if danger be still visible; if not, it will prepare to move. If the enemy be discovered while it is trying to escape, it again assumes its former submissiveness.

The actions of the spreading adder are also curious. If approached, it makes a hissing noise and starts forward, looking as hideous as possible, as though it would frighten its enemy. These motions it will repeat several times if touched with the finger or a stick; but finally it seems to despair of relief by that method, and throws itself on its back and utterly refuses to make further defense. On first observing this peculiar position, I was sure the reptile was dead; but on returning a few minutes later to the box in which I had it, found it looking all right. The same effect followed the repetition of the teasing. When I turned it right side up, it immediately turned back again. Repeated experiment since with these snakes has shown that they even resist with muscular effort a change from their unnatural position.

Many beetles have habits similar to those of the animals named, and, like them, their pretense is overdone. When the Colorado beetle, or potato-bug, falls from the potato-vine on being approached, it nearly always comes to the ground with the feet up.

Many other examples might be given; but the above, I think, are sufficient to show that the theory that in the phenomena under consideration the animals are helpless from fright is untenable. In almost every case the animal manifests consciousness, shows itself cognizant of the situation, and betrays its anxiety to escape. H. L. ROBERTS.

LEWISTOWN, ILL., *February* 23, 1882.

## SENSE OF DIRECTION IN ANTS.

*Editor Popular Science Monthly:*

A short article on the "Sense of Direction in Insects," in the February number of "The Popular Science Monthly," served to remind me of an account of the travels of an ant told me by my father, the late Prof. Lyford. His attention was drawn to the insect by a very heavy load which it was carrying. When first noticed it was traveling along a gravel walk in most approved fashion, and, while occasionally avoiding a large pebble, was pursuing in the main a very straight line. But soon it turned from the walk, and taking a different direction entered a grass-plat. Here a different mode of proceeding was adopted. Finding it difficult to walk around the grass-stalks, it would climb to the top of the blade, let it bend down with its weight, then get off and climb a second, and so on. Besides making quite satisfactory progress in this manner, the top of the grass-blade seemed to furnish a convenient point of observation, like a tree-top in a forest. Through the grass the route was very direct until it reached its "*hill*," when it disappeared. A careful calculation of the distances traveled on the gravel and through the grass, and of its rate of progress over the two, indicated that, while the total distance was greater than if measured in a straight line, yet that the insect had actually selected, very nearly if not exactly, the route which could be traversed in the shortest time, seeming to realize that in this case at least "the longest way round was the shortest way home."

Edwin F. Lyford.

Springfield, Mass., *February* 20, 1889.

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## JAPANESE MAGIC MIRRORS.

*Editor Popular Science Monthly:*

In the February number of the "Monthly," in the "Miscellany," page 572, Prof. Mendenhall's account of the Japanese "magic mirror" is quoted. The reason which he gives for the peculiar property that a few accidentally possess of reflecting upon a screen an enlarged image of the figures in relief on the back of the mirror seems to me, to say the least, questionable.

While in Japan I became intensely interested in the phenomenon, which has been explained in many ways. By the process of exclusion, all for the time being were discarded but two. The first of these is given by Prof. Mendenhall, viz., "When the mirror is cast the cooling process has the effect of drawing it slightly out of shape"; and the second endeavored to answer the question by supposing that in the casting there was produced a difference of density opposite the ornamentations, which are in decided relief. It was argued that the more dense portions would be abraded less in the operations of grinding and polishing than the softer parts, hence leaving them a very little in relief. There is no design, in the mind of the artist, for an unequal density in the casting, and, so far as I am aware, there is no proof that it exists. In observing the mode of grinding the face for the final polish, it appeared quite evident that all "drawing" and differences in density would be reduced to quite the same level. The process of final finish seemed to me to solve the puzzling riddle, which is as follows: When the moderately convex surface has been brought to a satisfactory and equable condition, the casting is placed upon a solid base, on which the figures in relief firmly rest, leaving the intervening spaces practically unsupported. In order to get all the "drawing" and unevenness out of the face of the casting, some are ground thinner than others. The final polish is given by violently rubbing the surface with the rather small end of a soft-wood stick, applied with heavy pressure. It seems evident that when the stick passes from the thick supported to the thin unsupported parts, the latter would be slightly depressed, and the continued rubbing pressure would fix these depressions, leaving slightly raised lines exactly opposite the ornamentations in relief on the back. These are so slight as not to be detected by the eye, but when cast from the convex surface on a screen at some distance the diverging rays would enlarge the image, so as to produce the fact of the phenomenon.

G. O. Rogers.

Apam, Mexico, *February* 1, 1889.

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## SELF-POISONING BY SNAKES.

*Editor Popular Science Monthly:*

In your January number you say, "To what extent a poisonous serpent's bite is noxious to itself is doubtful"; and the testimony of Dr. Stradling there given tends to settle the doubt in the negative. Bearing upon this question is the following from Lieutenant Michler's report to Major W. H. Emory, United States Army, and bearing date July 29, 1856. It is to be found in Major Emory's report of the "United States and Mexican Boundary Survey," vol. i, pp. 121, 122.

"The glare of our fires attracted a large number of rattlesnakes; the whole place" (the "Sierra del Poso Verde") "seemed infested with them. We judged them to be a new species from their tiger-colored skins; they were exceedingly fierce and venomous. On the deserts of the Colorado we had often seen others with horns, or small protuberances above the eyes; and Dr. Abbott has taken from the body of still another species quite a number of small ones, among which was a monstrosity with two perfectly formed heads attached to one neck. When you lie down on your blankets stretched on the ground, you know not what strange bedfellow you may have when you awake in the

morning. My servant insisted upon encircling my bed with a *riata* of horse-hair to protect me from their intrusions. Snakes are said to have a repugnance to being pricked by the extremities of the hair. The *paisano*, or chaparral cock, surrounds his antagonist, while asleep, with a chain of cactus-thorns. When the preparations are all made, the bird flutters over the head of the snake to arouse it to action; the latter, in its vain efforts to escape, is irritated to such a degree by running against the barrier encompassing it, *that it ends its existence by burying its fangs in its own body.*"

To what end or purpose is all this wonderful strategy on the part of the bird? Is it simply to imprison the snake? Is it for the fun of seeing the reptile fooled? Is it merely that the snake should "inflict only mechanical injury upon its own body" which would not be at all likely to prove fatal; or is the whole story false?

A. J. WILLIAMS.

CLEVELAND, OHIO, *February* 21, 1889.

## EDITOR'S TABLE

### *INTELLECTUAL INTEGRITY.*

MILL'S "Essay on Liberty" and Darwin's "Origin of Species" mark the opening of what we may regard as the latest chapter in the history of modern thought. Mill vindicated for all men the right, not only of using their individual judgment, but of expressing their individual opinions, upon all subjects whatsoever, and proclaimed it to be at once the duty and the interest of society at large to see that no impediments were cast in the way of such exercise of intellectual liberty. Darwin furnished almost at the same moment a theory which ran so strongly counter to received opinions that to espouse it demanded no small amount of intellectual courage, and to discuss it fairly on its merits, without any appeal to theological prejudices, a somewhat rare degree of liberality. Darwin seemed to say to a society that had just received Mr. Mill's essay with acclaims of praise: "Well, here is a touchstone of your sincerity; here is a doctrine which I have carefully thought out, and which, if true, involves a complete reconstruction of many of your most cherished ideas: can you do it justice? Can you do justice to those who may accept it?" Outside of the theological colleges the world responded fairly well to the appeal, and "The Origin of Species," though keenly criticised, received the treatment due to a serious intellectual effort. How far the theological colleges, or the theologically governed colleges, lagged behind may be judged from the comparatively recent period at which a professor of eminence was removed from his chair in a Southern college because he had embraced and taught Darwinism in a very mild and inoffensive form.

The question, however, at which we wish to glance very briefly, is not as to the merits of Darwinism, but as to whether a better basis for the claims of modern thought might not be found on the lines of Mill's famous essay than upon that profession of "agnosticism" to which so many nowadays betake themselves. A passage that falls under our eye, from a French moralist of the seventeenth century, may help to illustrate our meaning. "There is," says Nicole, the friend of Pascal, "a duty of *conviction*, which arises when we are face to face with *evidence;* a duty, also, of *doubt*, because it is absurd not to be in doubt regarding doubtful things; and a duty of *opinion*, because we are obliged to affirm that one thing is more probable than another, if proof to that effect is offered." Now, what a modern thinker may justly claim is, liberty to do what Nicole calls his "duty" in these three particulars: to believe in things certain, to doubt of things doubtful, and to have an opinion where the evidence, though not demonstrative, is sufficient to establish a probability. But from which of these three phases of duty should he choose a name for himself? Would it

not be equally absurd for him to call himself a "believer," or a "doubter," or an "opiner"? Surely he is all three, each in its turn; and, whether in believing, or in doubting, or in opining, he is equally maintaining his intellectual integrity. Taking this view of the matter, we have not hitherto been able to regard the "agnostic" position as very well or happily chosen by many, at least, of those who profess to hold it. We think, for example, that "agnostic" is a poor name for such a man as Prof. Huxley to be known by. Prof. Huxley is a man of a decidedly positive and constructive cast of mind, a man eager to affirm all the truths that he can establish. If he makes a stand for anything, it is for intellectual integrity. To him it is a crime to believe without evidence, or to disbelieve in spite of evidence. In this respect he is entirely at one with the excellent Nicole, whose words we have quoted. Why should a man of this kind be separated by any badge or party nickname from the community at large? His one great interest is the truth, and what nobler interest can any man have? Or, again, what profounder basis of sympathy and union can any two men, or any body of men, have, than a common and ardent love of the truth? Mere outward agreement in opinion counts for little, unless there is sincerity at the back of it. It is impossible, at least for any enlightened man, to derive satisfaction from the support of those who, he knows, have no interest in the truth, and who are prepared to defend the opinions they have embraced by all kinds of party strategy.

The highest profession any man can make is a profession of intellectual integrity; and to us it seems to be sufficient for all purposes. It is one which a man can summon others to share. It becomes at once the basis of a true apostolate. "Believe what you may," cries the true modern thinker, "disbelieve what you may, only make it a sacred principle that your beliefs shall be honest, and shall be advocated and defended by honest arguments and none other." It may seem to some that this is an appeal easily made, a programme easily realized. Possibly, but it demands this: that underneath every opinion and belief shall be a fundamental sense, acquiring gradually the force of an instinct, that the ultimate object of loyalty and devotion is the truth. Truth, if we may so express it, must own the soil of the mind, and opinions and beliefs must be merely tenants occupying according to the terms of their several leases. Loyalty to an opinion is a misleading phrase, and one that ought to be banished from the vocabulary of honest men. The only true and worthy loyalty is to that which alone can vitalize any opinion—namely, the truth.

If it be objected that there is no convenient name by which the brotherhood of truth-lovers could be known, we answer that the objection seems to us of trifling importance. The great thing is that a man should be a truth-lover, not that he should have any special appellation. The Christians "were first called Christians at Antioch"; and St. Paul founded churches without, apparently, using or recognizing the name, which is not once mentioned in his epistles. The "Methodists" of the last century took a name that was applied to them mainly in derision by their opponents, and one which certainly did not bind them to any set of opinions. Let a man profess and, still better, let him practice honesty in all his beliefs, and let the world dub him as it may. He will then be prepared to say, when duly questioned, what those things are which, following the pious Nicole, he finds it a duty to *believe*, the evidence being what it is; what those things are which to his honest apprehension are *doubtful;* and what those in regard to which he is moved by a greater probability to entertain an *opinion*. The things that he disbelieves he will also with equal frank-

ness declare, and his disbelief will be governed by a sense of duty as much as every other attitude of his mind. There is great need in the present day for those who love the truth in sincerity to seek one another out, and to strengthen one another for the great conflict that has incessantly to be waged with the forces of error, of falsehood, and of moral indifference. What can separate any man, against his will, from the love of the truth? And what should separate from one another men who, though differing momentarily in opinion, love the truth with constant and equal devotion?

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### *AN UNCANDID CRITICISM.*

We find in the March number of the "Canada Educational Monthly," published at Toronto, the following remarks about Dr. Andrew D. White and "The Popular Science Monthly":

"The same number [of 'The Popular Science Monthly'] contains the concluding portion of Dr. Andrew White's article on 'Demoniacal Possession and Insanity.' Dr. Andrew White 'seemeth to be somewhat,' but, we think, many thoughtful readers will say, 'he addeth nothing to me.' Probably the best article in the number, for most of our readers, will be that on 'Natural Science in Elementary Schools.' Sometimes the 'Popular Science' is worth reading carefully, but at other times it is somewhat unsatisfactory, and many of its writers seem to have atheistical tendencies, so that its pages are occasionally disgraced by remarks about Christianity which are too spiteful to be scientific."

Dr. Andrew D. White is what he is, and whatever he "seemeth to be" to the editor of the "Canada Educational Monthly" will not alter the facts. The ex-President of Cornell and our late Minister to Germany does not need that we should sound his praises as a man of wide and accurate knowledge and of philosophic habit of mind. What must have struck every careful reader of his recent articles is, that he handled his subject with the utmost regard for the feelings of those to whom some of his conclusions might have been unwelcome; and it seems proper to remark that, if he "added" nothing else to the editor of the "Canada Educational Monthly," he might have added—had his example been sufficiently heeded—a tone of respect in dealing with the opinions of opponents. It is easier, however, to sneer than to argue, to insinuate than to prove or disprove. If Dr. White has presented his subject in a false light, let the "Canada Educational Monthly" demonstrate the fact. It is hard to "add" anything to people who do not want to have anything added to them except, perhaps, an extra layer of prejudice; but, in the way of adding information, that writer does his own full duty who states relevant facts in a lucid and candid manner. If Dr. White has not done this, let his critics show it. We are not responsible for our contributors' opinions; but, in the name of intellectual honesty and literary morality, we protest against such criticism as that quoted from our Toronto contemporary.

As to "The Popular Science Monthly," we have no doubt that our habit of letting the leading thinkers of the world express their opinions through our pages is very distasteful to many who still cling, more or less tenaciously, to the slowly decaying superstitions of the past. But the columns of the "Monthly" will bear witness that these discussions, though in the main outspoken, have always been dignified in tone, and as considerate of the feelings of others as the utmost courtesy can require.

"The Popular Science Monthly" endeavors to represent the scientific culture of the age in all its fullness and variety; and it is happy to know that, in doing so, it has the sympathy and support of a very wide circle of readers, including most of the prominent edu-

cators of this continent. Our firm belief is, that the truth can take care of itself—that it does not need any bolstering or hedging round or underpinning; and we therefore throw our pages open to any one who can discuss a timely subject bearing upon the progress of human interests in a scientific manner. We know of no other principle upon which a "Popular Science Monthly" could be honestly or successfully conducted; and, as to our pages being 'disgraced by remarks about Christianity which are too spiteful to be scientific," we can only say that an unsupported charge of this kind, in the face of the record made by the magazine from its beginning, need give us extremely little concern. Some time ago we had occasion to remark that a single number of the "Canada Educational Monthly" contained two articles borrowed from "The Popular Science Monthly"—one of them without acknowledgment. We think that such practical approval of the wares we offer the public goes far to set off the illiberal criticism above quoted from the same quarter.

## LITERARY NOTICES.

THE FOLK-LORE OF PLANTS. By T. F. THISELTON DYER. New York: D. Appleton & Co. Pp. 328. Price, $1.50.

FOLK-LORE is always a fascinating study, and no branch of it offers more of peculiar interest than that of plants. Prof. Dyer, therefore, has chosen a popular theme, one that has engaged the attention of many writers before him, and the present volume is a condensation in large part from previous books and papers upon the subject. In the author's own prefatory words it is "a brief, systematic summary, with a few illustrations in each case of the many branches into which the subject naturally subdivides itself." The book before us is, therefore, a hand-book to all who are interested in the subject upon which it treats. A mention of some of the twenty-three chapters into which the work is divided will help to present a faint idea of the scope and success of Prof. Dyer's compilation. Plants in witchcraft, plants in fairy lore, love-charms, plant language, doctrine of signatures, sacred plants, plants in folk-medicine, and mystic plants; these are suggestive of the careful systematic work done by the author. It is impossible to epitomize a work of this kind which in itself is an epitome of a vast subject. The foot-notes and references, one or more on nearly every page, illustrate how very wide has been the gleaning of the painstaking author. Open the book at any page, and a pleasing, succinct statement will be found of some ancient superstition of plant spirit, plant worship, plant witchery, plant demonology, or plant legend.

Darwin, in his famous work upon "Movements of Plants," says: "Why a touch, slight pressure, or any other irritant such as electricity, heat, or the absorption of animal matter should modify the turgescence of the affected cells in such a manner as to cause movement we do not know." In the light of this frank confession of ignorance by one of the wisest of Nature's modern students it is not strange that during the early ages of the world every living thing was believed to be under the direct control of some spirit, good or evil, which was none the less real to the ignorant people because unseen. It was natural for the ancients to ascribe causes to well-established effects, and the world of plant life came in for its full share. They believed blindly in the vegetable origin of the human race—that is, man sprang from some sacred world-tree. In modern times the belief is not altogether different from this, but the method is through the gradual unfolding of the higher from the lower by the slow process of evolution. In like manner the ancients, in seeking for a divinity, ascribed superhuman power to the mighty oak, and clothed other trees as with the garb of gods. The worship of to-day is often of structures far less lofty and inspiring than the forest giants. In our time we can with profit glance back and note the growth of ideas as they broaden with the ages and see that our own idols must be broken in pieces by the relentless wheels of progress. This is one of the good features of such books as the one before us, and should make them popular, because being a history of the people in every-day life—their common thought and conversation.

We must remember that the day of folk-lore is not past; superstition has not given place to science, and the reign of isolated absurdities still holds sway in many minds in place of law and order. It may be no worse to attribute the hidden evil of the world to plants possessed of Satan than to believe that there is a creature with horns and a cloven foot seeking for the innocent to satisfy his capacious maw.

Some of the most charming examples of plant lore are found in that portion having to do with fairies. Of course, the fairy itself is a pleasing myth that will require many ages to eradicate from the human mind, because it adds so much of innocent beauty to a majority of the nursery rhymes and children's tales. The whole deception of Santa Claus is one born to an endless earthly life, because having only a happy and healthful influence upon both the old who practice it and the young who are so delightfully deceived. There is a perennial pleasure in the thought that a tulip-blossom is a cradle in which mother fairies lull their little ones to sleep. To this day the finder of a four-leaved clover is considered by many as a person born to good luck—a notion that has descended from an older idea, namely, that the monstrous leaf was a talisman which enabled its wearer to detect the haunts of fairies. Much of fairy lore clusters around the so-called fairy rings, that is, the green circles in old pastures within which the elfs were supposed to dance at night by the light of the moon. Modern science has extracted the last breath of poetry from this common phenomenon and left it as a dry fact in the cyclopædias.

Flowers play no insignificant *rôle* in love-making at the present day, and no school-girl's botany is complete unless she can discourse fluently upon the language of flowers. Some plants are naturally symbolic of certain ideas. Thus, grass readily may stand for usefulness and the cypress for mourning, the poppy for sleep, and the trembling aspen for fear. Other plants do not carry their florigraphical meaning in plain sight, but have acquired their adopted meaning in ways that are lost in oblivion while the symbol remains. Thus the rose was dedicated to Venus by the early Romans and Greeks, and now stands for love, especially the deep red varieties. The constancy of the violet and the curiosity of the sycamore are far less evident than the weeping nature of the drooping willow.

The degree of credence given by many to the strange stories of fabulous plants is one of constant surprise to those whose knowledge shows up the traditions in their true light. The barnacle-tree is an instance to the point, and the following is a sixteenth-century description of it: "There are found in the north of Scotland and the isles adjacent, called Orcades, certain trees whereon do grow small fishes of a white color, tending to russet, wherein are contained little living creatures; which shells in time of maturity do open and out of them grow those little living things which, falling into the water, do become fowls whom we call barnacles, in the north of England brant geese, and in Lancaster tree geese; but the others that do fall upon the land perish and do come to nothing." There is more foundation in fact for this exaggeration of trees which, overhanging and dipping into water at high tide, may bear barnacles than in the wonder-working moonwort which would open locks, and unshoe horses treading upon it—certainly a very unsafe herb in the hands of unscrupulous house-breakers—providing the fable were true. Under the "doctrine of signatures" the author brings together a large amount of interesting matter illustrating the old idea that each medicinal plant has some sign of color, shape, etc., which indicates its healing power either for the whole body or for some particular organ. For example, red juice is for the blood, yellow for jaundice, the liver leaf—shaped like a liver—for the liver, etc. This doctrine was carried to an almost amusing excess. Thus, the shell of walnut, which resembles a human skull somewhat, was used for troubles of the brain. The aspen was employed for palsy; and mistletoe, a plant that grows in a suspended position, was good for dizziness.

Young people even could find much amusement in the chapter upon games, having plant lore as the basis and often set to rhyme.

Folk-lore in medicine is a vast subject receiving its full measure of treatment. Strange are many of the rhymes in this section of the subject. A single couplet is here indulged in:

"Eat an apple going to bed,
Make the doctor beg his bread,"

which is only a striking way of saying—

That apple eaten upon retiring
Is better than the doctor hiring—

a statement that may not be in accord with the teaching of the theory and practice of modern medicine.

The book before us is full of weird things that cast a peculiar light upon the past, and add new luster to the present. The human mind in the early centuries was saturated with unaccountable notions of the wildest sort. Prof. Dyer has shown a master's hand in dealing with the occult theme. He has been happy in his selections, conscientious in treatment, and clever in the grouping of the otherwise almost isolated and independent fables, superstitions, and legends.

INTERNATIONAL LAW. By HENRY SUMNER MAINE, K. C. S. I. New York: Henry Holt & Co. Pp. 234. Price, $2.75.

THE series of twelve lectures here published was delivered before the University of Cambridge in 1887, by the late Sir H. Maine, then Professor of International Law on the foundation of Dr. Whewell. In speaking of the sources of international law the author says that a great part of it is Roman law spread over Europe by a late stage of the process by which the general body of Roman law had obtained authority over the same territory. It was the part of Roman law which had been called "Law of Nations," or "Law of Nature," and which was originally a collection of rules and principles common to the institutions of the various Italian races. The author next considers the history of the conception of sovereignty, and how a state acquires unappropriated territory, also what degree of occupancy constitutes a valid claim over a given area. A consideration of the law in regard to jurisdiction in territorial waters, and on board merchant ships on the high seas, leads up to the subject of naval or maritime belligerency. The Declaration of Paris occupies part of the chapter on this subject and also a separate chapter. The author thinks that the condition on which the United States offered to assent to the prohibition of privateers in this document, namely, that all private property be exempt from capture, would be a very favorable arrangement for Great Britain, whose food-supplies and the goods sent to pay for them have to travel such long distances by sea. The mitigation of war is next taken up, and the means of injuring an enemy commonly prohibited are named, the subject of spies and stratagems is discussed, and the disposal of the wounded and other prisoners is treated. Certain relations of belligerents on land, comprising military occupation, capitulation, and flags of truce, together with the subjects of captures and requisitions, occupy the next two chapters. In the statute regulating his professorship, Dr. Whewell enjoined upon the occupant of the chair that he should make it his aim, in all parts of his treatment of the subject, to lay down such rules and suggest such measures as might tend to diminish the evils of war, and finally to extinguish war among nations. Accordingly, the professor devotes his closing lecture to the measures for the abatement of war proposed within recent years. In this chapter are considered the opposition to war on religious grounds, the substitution of arbitration for war, touching upon the defects of international courts, with a mention of De Molinari's proposal that it should be one of the duties of neutrals to combine to thwart the spirit of belligerency. These lectures were not prepared for publication by the author, but have passed through the press under the direction of Mr. Frederic Harrison and Mr. Frederick Pollock.

THE ECONOMIC INTERPRETATION OF HISTORY. By JAMES E. THOROLD ROGERS. New York: G. P. Putnam's Sons. Pp. 547. Price, $3.

PROF. ROGERS develops English history from the standpoint of an economist, and brings to his task a rich mine of records hitherto neglected. As readers of his "Six Centuries of Work and Wages" are aware, he has been a diligent delver into the elaborate accounts kept in England since the thirteenth century by farmers, builders, and landlords. These and the court rolls of manors have enabled him to ascertain the variations for six hundred years in prices, wages, rents, and taxes. We are told what people ate and drank, how they were housed and clothed, and what some of them were able to save. This new light shed upon the hearth, wardrobe, and dinner-table evidences in a very

striking way how progress and retrogression have succeeded one another in England. Prof. Rogers's work is a notable contribution to the modern view of history, which looks not so much at the conspicuous and picturesque elements of national life, the contests of courts and battle-fields, as at the daily life of the common people; which busies itself with their progress in the arts and sciences, their success in translating justice into law, and the consequences due to change of conviction as to the rights of the citizen and as to truth in religion.

Prof. Rogers shows that in many ways the common people in the middle ages were better off than they are now. Although the standard of living was low, want was rare. The best workmen, associated together as guilds, purchased lands and houses throughout England for charitable service to their order, and so in a spontaneous, wholesome way effected an insurance for old age and infirmity. In the fifteenth century skilled workmen, such as carpenters, and masons, worked but eight hours a day; this, too, without invoking legislation for the purpose. So skilled were some of these men that they combined the talents of both design and execution, and planned the churches, guild-halls, and cathedrals they afterward helped to build.

Rent was at first a tax imposed by the lord for the protection he extended. For arable land in six centuries rent has been multiplied tenfold in comparison with the price of grain. Competitive rents were of very gradual introduction by the landed classes, who in the main have been grossly unjust in evading taxation and in increasing privileges while ignoring the responsibilities originally attached thereto. Once, property was almost universally diffused, and at that time Prof. Rogers believes the respect for property, still so characteristic of Englishmen, to have been implanted. Because its sheep-pastures were secure from the invader and untouched by the thief, England for three centuries enjoyed a monopoly of wool production in Europe, enormous in value. Prof. Rogers is of those who accord a supreme molding potency to circumstances and conditions; he holds the drunkenness and unthrift of the English working people to be largely chargeable to the demoralization of unjust poor-laws, and the oppressions of a landlordism which at last extorted famine rents. While he has devoted his life to the study of political economy, he sees that that science takes but a partial view of man and not the highest view; and that no one can understand political economy who does not take some trouble to understand human nature—its sentiments, affections, passions, and hopes. It is refreshing to find an economist who has had the expanding experience of a long parliamentary career and a varied knowledge of men and things the world over. Such a man, possessed of a new and rich store of fact, brings a new treatment to the well-worn themes of currency, pauperism, colonial policy, and the extension of the sphere of government into the field of business. His chapters, delivered as lectures at Oxford, have the freedom if albeit the dogmatism of a veteran discoursing to his juniors. Still they have a ring of manliness and humanity which much heightens the effect of his teaching. He has some plain words for the economists of the arm-chair who give verbal symmetry to incomplete and second-hand impressions—men who are plainly in sympathy with those who have wealth and comfort rather than with those who create these things.

BEAUTY, HEALTH, AND STRENGTH FOR EVERY WOMAN. By OSCAR B. MOSS, M. D. Ann Arbor, Mich.: The Register Printing and Publishing House. Pp. 376.

"I AM not able to recall," says Miss Catherine E. Beecher, "in my immense circle of friends and acquaintances all over the Union, so many as ten married ladies, born in this century and in this country, who are perfectly sound, healthy, and vigorous." A large share of the women in any one's acquaintance in America are delicate, or have frequent fits of sickness, or general poor health, or are chronic invalids. There is little of this disease that is not preventable by faithful use of the medical knowledge that we now possess. To make this knowledge known to the women of America, and to impress them with the importance of guiding their mode of life by it, are the objects of Dr. Moss's volume. The first practical subject which the author treats is diet, and this is followed by a chapter on the dress of young girls. In the next chapter the physio-

logical and psychological changes that occur when the girl attains the age of puberty are described. Mental and physical culture are the next two subjects considered, and under the latter head certain gymnastic exercises adapted to develop various parts of the body are specified. Woman's dress, the hygiene of the monthly period, marriage, the hygiene of pregnancy, and the change of life, are treated in a simple practical fashion. The last chapter is devoted to beauty, and tells women the most effective ways of securing beauty for themselves, and of transmitting it to their children. The treatment is plain, practical, and popular throughout.

MENTAL EVOLUTION IN MAN. ORIGIN OF HUMAN FACULTY. By GEORGE JOHN ROMANES, M. A., LL. D., F. R. S. 8vo. Pp. 452. D. Appleton & Co. Price, $3.

THIS is the most important scientific work that has appeared in many months. It follows in logical sequence upon the author's former book, "Mental Evolution in Animals," and is intended to be the first installment of a series which the writer says will deal with the intellect, emotions, volition, morals, and religion. The present volume is concerned chiefly with the *origin* of human faculty, as distinguished from its development, and is mostly limited to the psychology of the subject, postponing anthropological evidences for the next installment.

Dr. Romanes takes for granted the general theory of evolution, including the evolutional doctrine of descent "as regards the whole of organic nature, morphological and psychological, with the one exception of man." Even with man this assumption is continued so far as his bodily organization is concerned; it being thus only with reference to the human mind that this exception is allowed. The effort is then made to show that the same doctrine is applicable also to the mind of man, or to "human faculty."

In the last number of "The Popular Science Monthly" extracts were given from the work before us sufficient to indicate the main positions taken and the line of argument pursued, which circumstance renders it unnecessary for us to give in this place even an outline of the course of exposition. One thing, however, ought to be observed, which did not appear in the article referred to. The controversy centers around the problem of language and the mental acts involved in predication. The task of proving that these require and exemplify nothing more than higher and more perfect developments of powers the same in kind as those found lower down in the scale of animal life, is pursued with great ability and thoroughness, and with a conclusiveness which will impress itself upon every thoughtful and candid mind. The greater part of the volume is taken up with this examination of language and the mental processes involved therein. The result is to bring out in a manner never hitherto accomplished that language itself, its formation and constitution, furnishes a demonstration of the necessary continuity of development from the animal intelligence, to explain the "origin of human faculty."

This splendid work of scientific achievement brings forward into full view of the world of science a second Darwin. No doubt such an assertion is a bold one, but we are persuaded that it is just. Not only is the work done a continuation of that of the author of "The Descent of Man"; but in his single-mindedness in the search for truth, in his careful, conservative judgment, in the thoroughness of his analysis, in his readiness to hear and patiently examine objections, in his plain, clear style of expression, Dr. Romanes more nearly approaches Darwin than has any other scientific writer. The present work is a magnificent one, and we shall await with eagerness the others that are to follow.

DAYS AND NIGHTS IN THE TROPICS. By FELIX L. OSWALD. Illustrated. Boston: D. Lothrop Company. Pp. 186.

THE young or old reader who takes up this book can not fail to be charmed with the vivid scenes of animal life which it portrays. It contains the experiences of the author in a trip through the forests of Brazil to collect native natural history specimens for a national museum in Rio Janeiro. Both entertainment and information are afforded by its accounts of the doings and habits of monkeys, boas, various members of the cat family, birds, manatees, insects, ant-eaters, and the scarcely more domesticated children of the forest—the Indians. The surprising toleration which pet-keepers and pet-dealers

exercise for the mischief and impudence of their charges is well portrayed in several places. The text is not burdened with technical names, and the many spirited illustrations, together with the tasteful cover, add to the attractiveness of the book.

SOCIAL PROGRESS: AN ESSAY. By DANIEL GREENLEAF THOMPSON. London and New York: Longmans, Green & Co. Pp. 161. Price, $2.

THIS work forms a part of the same series of philosophical discussions to which the author's earlier volumes belong. Its special object is to present the principles that control the progress of society, a knowledge of which will enable men to direct their movements as social units so as to produce the most useful work with the least friction. The essay is substantially the introduction to a longer work, on which the author is engaged, entitled "The Fundamental Rights of Man." The two chief topics of this book are the conditions and the promotion of social progress. Every individual desires his own advancement, says the author, and closely bound up with this ideal of individual betterment is an ideal of social improvement. If there be either individual or social progress, there must be *liberty* for action. But the conflicting efforts of antagonistic individuals will neutralize each other if they are not restrained. This restraint is furnished by *law*. But too much restraint is as destructive as none. Hence the general condition essential to social progress is the establishment of an equilibrium between liberty and law. Men dwell together in the organic relations of society because this state allows each individual to attain a greater number of desires than he could in a solitary and hostile existence. The existence of society requires a social liberty—that is, the recognition of rights due each member of the community, and the limitation of the acts of every one by those rights. The nature of men makes necessary the defense of social liberty by positive law, with machinery to enforce it unfailingly and consistently. No government can be stable that does not insure equality in rights at least between those of the same class, and a government which depends upon the existence of classes tends to instability as knowledge becomes diffused among the least favored classes. Inequality of power, whether political or ecclesiastical authority or wealth, is dangerous to security and should be resisted. One more condition essential to the progress of society is fraternity—a disposition to prefer the good of the whole to the selfish interest of the individual.

In the part of the volume devoted to discussing the promotion of social progress Mr. Thompson calls attention to the fact that in every community there are observable two opposed tendencies with regard to the existing order of things: one toward change, the other resistance to change. The terms *radicalism* and *conservatism* have been used to express these antagonistic forces. Men unfortunately tend to range themselves as adherents of one tendency or the other, and any idea which bears the name of one party is scouted by the other. In the social organism, as in the human body, change is essential to life, and, when the changes which constitute the vital processes stop, death ensues and disintegrative changes begin. Mr. Thompson states as the general principles governing the promotion of social progress, that opportunity should be afforded for the action of evolutionary forces; that changes favoring the common freedom should be aided; and that equal enjoyment and security of life, liberty, and property are the test of common freedom. Further, in order to decide whether to aid or oppose a given change, we should examine the motives of its proponents and its opponents, estimate both the immediate and the remote consequences of the proposed change, consider the result of leaving things as they are, and calculate the probabilities of accomplishing the change and the results of failure. For the formation of opinions that will be reliable guides to conduct, self-knowledge and self-control in individuals are prime necessities. The habit of being suspicious of the correctness of one's positions and of the justice of one's sympathies and antipathies ought to be systematically cultivated. Opinions should be expressed freely though judiciously, in order to get the benefit of criticism, upon them. Action should be controlled by an extension and more careful application of the same rules which ought to govern expression of opinion. Compromise and forbearance are sometimes the most effective action. While Mr. Thompson in his

opening chapters insists on the necessity of regulation for the world as it now exists, he says in closing: "As we draw nearer to perfect social conditions positive law will grow less necessary. If all men had the true altruistic disposition, there would be no need of government. The course of progress is from the anarchy of the primitive state through law and government to the anarchy of the perfect state. We should aim, then, to diminish the restraints of authority, and, though working cautiously and tentatively, should seek ever to contract the sphere and minimize the duties of government. Only thus can that City arise into which the glory and honor of all the nations may be brought." Mr. Thompson's "Social Progress" will be a very helpful book to the student of public affairs who desires to look below the foaming, eddying surface of the stream of events, and see the strength and direction of the currents that determine the course in which society may advance.

*A Study of Man, and the Way to Health*, by *J. D. Buck*, M. D. (Clarke, $2.50), may be described as a series of essays philosophical in character, though popular in style. The body of the work opens with a chapter on the nature of evidence; then follow sections on the relations of matter and force, the universal ether, the character of phenomena, polarity, the matter of life, the forms of life, and the functions of organisms; or a brief outline of the principles of biology. An important chapter is devoted to a concise outline of the structure and functions of the human body, from which is deduced the philosophy of physiology, and upon which is laid the foundation of the science of psychology. Then follows a section on consciousness and psychic phenomena in general; a chapter on health and disease; a section on sanity and insanity; and the work closes with a section on the higher self, the archetypal man. The author is not at war with either science or religion, though he aims to get rid of both ignorance and superstition.

The little book entitled *Living Matter*, by *C. A. Stephens* (The Laboratory Company, Norway Lake, Me., $1), is an attempt to explain the constitution of the universe on the supposition that matter is sentient. The author credits to matter only "a sentience of low degree, in quantity far, very far beneath that evinced by even the lowest forms of life." Biogen, or living matter, forms all tissues of the animal body. Mr. Stephens gives an explanation of the method in which animal organisms are developed on the biogen hypothesis. He accounts for aging and death as resulting from changes in biogen, every one of which "is of the nature of an ordinary physical cause fairly within human power to avoid or remedy, and many of which in fact we are every day avoiding and remedying." This leads up to a suggestion of the possibility of learning how to prevent death altogether.

There has been printed *A Classified List of Mr. S. William Silver's Collection of New Zealand Birds*, with short descriptive notes by Sir *Walter L. Buller* (London, E. A. Petherick & Co.). A part of this collection, which is one of the most complete in Europe, formed a very attractive feature in the New Zealand Court, at the Colonial and Indian Exhibition in London, in 1886, and was awarded a diploma and medal. To the eight cases then exhibited, four have since been added, containing many of the rarer birds of New Zealand. Many of the genera and most of the species are strictly confined to New Zealand and the neighboring islands. The volume is copiously illustrated with heads, and in many cases full figures, of the typical species, besides many cuts of nests. An interesting object included in this collection is a frame of feathers of the moa, discovered in a cave in New Zealand by Mr. Taylor White in 1874.

*The Forty-first Report on the New York State Museum of Natural History* contains the reports of the trustees and the director, which relate the general progress and changes in the museum during 1887. In the report of the botanist it is stated that since the summer was unusually favorable to the production of fleshy fungi, the hymenomycetes, special attention was given to the collection and sketching in colors of these plants. The document is accompanied by reports of finding a large number of plants in various localities; by a paper on "Fungi destructive to Wood," contributed by P. H. Dudley, C E.; and by a botanical index to the museum reports Nos. 22–28. The report

of the entomologist occupies the greater part of the volume, and contains more or less extended notes on a large number of insects of economic importance. The report of the geologist is brief. It is accompanied by an account of the finding of the bones of mastodon associated with charcoal and pottery at Attica, and by descriptions of new species of *Fenestellidæ* of the lower Helderberg, with Plates VIII to XV.

Part II of the *Report of the Chief Signal Officer* for 1887 (War Department) consists of a "Treatise on Meteorological Apparatus and Methods," by Prof. Cleveland Abbe. The subdivisions of the subject are: the measurement of atmospheric temperature, of atmospheric pressure, of the motion of the air, of aqueous vapor, and of precipitation, all of which are treated with great fullness. Plates containing ninety-eight illustrations are appended to the volume.

A *Star Atlas*, with explanatory text by Dr. *Hermann J. Klein* (E. and J. B. Young & Co.), has been issued, containing maps of all the stars from 1 to 6·5 magnitude between the north pole and 34° south declination, and of all nebulæ and star-clusters in the same region which are visible in telescopes of moderate powers. The volume contains a little preliminary text, followed by descriptions of the more interesting fixed stars, star-clusters, and nebulæ contained in the maps, arranged in order of right ascension. Of the eighteen double-page maps, twelve are devoted to stars and six to the other objects. The atlas is finely printed on heavy paper.

A little volume of *Chemical Lecture Notes* has been published by Prof. *Peter T. Austen* (Wiley, $1), which the author says is "simply a collection of notes and observations on certain topics which experience as a teacher has shown me often give the student more or less trouble." Explanations are given of most of the principles of chemical philosophy, and about one fourth of the volume is devoted to an essay on "The Chemical Factor in Human Progress."

A former zealous propagator of Volapük, Prof. George Bauer, has invented what he deems a still better universal language, which he calls *Spelin*. A pamphlet giving a sketch of this language, translated and abridged from an exposition of the system by the author, has been issued by *Charles T. Strauss*, 424 Broadway, New York. The principal advantages claimed for Spelin over Volapük are that it contains no sound not occurring in all three languages, English, German, and French; it has no declension, no subjunctive mode, only five tenses, nearly twice as many monosyllabic words in flowing sentences as Volapük, fewer letters for expressing the same thoughts by seventeen per cent, more frequent vowel termination, and no words of five, six, or more syllables. The brief summary of its grammar in this pamphlet shows that Spelin is well worth examination by any one who is in search of the best universal language.

*The Patriotic Reader*, compiled by *Henry B. Carrington* (Lippincott, $1.20), is a large collection of "utterances that inspire good citizenship," in prose and verse. The selections are classified in sixteen parts, the first referring to the Hebrew and related nations, the second to the Greeks and Romans, and most of the others to different periods in American history. One division is composed of national hymns, songs, and odes, both of America and other countries. None of the grand and eloquent utterances in behalf of freedom for the slaves and the preservation of the Union, spoken before and during our civil war, are included. A biographical index of authors and persons whose deeds are celebrated is appended. The mechanical features of the volume are substantial and tasteful.

A book which is being very widely read is *Max O'Rell's* latest production, *Jonathan and his Continent* (Cassell, $1.50). The author gives hurried glimpses at a multitude of subjects, as if himself entered on the frantic race which he accuses Jonathan of running. His comments are light and entertaining, though many of his impressions have evidently been gathered from the funny columns of American newspapers.

*Lessing: Ausgewalte Prosa und Briefe* ("Selected Prose and Letters"), edited, with notes, by *Horatio Stevens White*, is the sixth of Dr. J. M. Hart's series of "German Classics for American Students" (G. P. Putnam's Sons). It presents typical specimens of the works of one of the most catholic and versatile of German authors—the one, perhaps,

who stands on a level with Goethe. The editor describes him as having been of "multifarious activity as fabulist, literary and dramatic critic, philosopher, and theologian." His "Laocoon" is one of the recognized classics in the literature of art. He was eminent as a classical scholar, archæologist, antiquary, poet, and dramatist — "a pioneer in the development of modern German literature." And there has been no figure in that literature "whose life is more laborious and fruitful, no character in an age of sentimentality which was more sane, stalwart, and manly." The selections present him in these various aspects, and the letters reveal features of his personality.

A translation of *Testa*, an instructive book for boys, by *Paolo Mantegazza* (Heath, $1.25), has just been issued. Its character may be quickest indicated by comparing it to "Sanford and Merton," though it has the advantage of being written for the present generation. Before this book appeared nothing of note, except De Amicis's "Cuore," had been written for children in Italy. "Testa" is a story of a boy who was sent to live for a year with a sagacious old uncle, a retired sea-captain, who, by telling anecdotes and by commenting upon various incidents, teaches his nephew many lessons in regard to the operations of nature, the ways of the world, and especially manners and morals. There is also some good counsel on the choice of a profession. In an early chapter is given a set of model resolutions for a month, and succeeding chapters contain blank pages for the young reader to fill with his own good resolutions for each remaining month of a year. The great variety of the book, and its Italian and, therefore, unfamiliar flavor, are enough to make it interesting to the average American boy, though only serious-minded boys will appreciate its full meaning.

The treatise on *The Psychic Life of Micro-organisms*, by *Alfred Binet* (the Open Court Publishing Company, 50 and 75 cents), has for its object to prove the existence of psychological faculties in the simplest organisms, and to describe their modes of manifestation. The sensibility and power of reacting possessed by these simple creatures is commonly called irritability. But M. Binet asserts that, "in these inferior beings, which represent the simplest forms of life, we find manifestations of an intelligence which greatly transcends the phenomena of cellular irritability." The author describes in successive chapters the psychic phenomena connected with the use of motory organs and organs of sense, with nutrition and fecundation, and he treats also the physiological function of the nucleus. He even goes further than is indicated above, and ascribes psychic faculties to the cells which make up the tissues of higher animals. He states that "the faculty of seizing food and of exercising a choice among foods of different kinds—a property essentially psychological—appertains to the anatomical elements of the tissues just as it does to all unicellular beings." In his views on the subject of this volume the author takes issue especially with M. Richet, and also with Prof. Romanes.

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## PUBLICATIONS RECEIVED.

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## POPULAR MISCELLANY.

**Preserving Timber from Moisture.**—The following recommendations are given by the Forestry Division of the Department of Agriculture in regard to the cheaper coatings for keeping moisture out of timber: Never apply paint or any other coating to green or unseasoned timber. If the wood was not well dried or seasoned, the coat will only hasten decay. Good coatings consist of oily or resinous substances which make a smooth coat capable of being uniformly applied. They must cover every part, must not crack, and possess a certain amount of plasticity after drying. Coal-tar, with or without sand or plaster, and pitch, especially if mixed with oil of turpentine and applied hot (thus penetrating more deeply), answer best. A mixture of three parts coal-tar and one part clean unsalted grease, to prevent the tar from drying until it has had time to fill the minute pores, is recommended. One barrel of coal-tar (three to four dollars per barrel) will cover three hundred posts. Wood-tar is not serviceable because it does not dry. Oil paints are next in value. Boiled linseed-oil, or any other drying *vegetable* oil, is used with lead or any other body, like powdered charcoal, which will give substance to it. Immersion in crude petroleum is also recommended. Charring of those parts which come in contact with the ground can be considered only as an imperfect preservative, and unless it is carefully done, and a considerable layer of charcoal is formed, the effect is often detrimental, as the process both weakens the timber and produces cracks, thus exposing the interior to ferments. Lastly, in communities where durable timber is scarce, it will pay to establish a plant for impregnating timber with antiseptics by the more costly processes described in "Forestry Bulletin" No. 1.

**Geological Progress.**—In reviewing the progress made by geological science during the last twenty-four years, Prof. W. Boyd Dawkins mentions the advantages which it has drawn from microscopic analysis of the rocks, in the study of metamorphism, and of the crushing and shearing forces that were brought to bear on the cooling crust of the earth; and from deep-sea explorations, revealing the structure and deposits of the ocean abysses. From a comparison of these deposits with the stratified rocks, we may conclude that the latter are marginal, and deposited in depths not greater than one thousand fathoms, or at the shore end of the globigerina ooze, and most of them at a less depth—and that consequently there is no proof in the geological record of the ocean depths having ever been in any other than their present places. In North America, the geological survey of the Western States has brought to light an almost unbroken series of animal remains, ranging from the Eocene down to the Pleistocene age. In these we find the missing links in the pedigree of the horse, and sufficient evidence of transitional forms to enable Prof. Flower to restore to its place in classification the order *Ungulata* of Cuvier. These may be expected to occupy the energies of American geologists for many years, and to yield further proof of the truth of the doctrine of evolution.

**Yucatan Hammocks.**—With a couple of straight poles, a shuttle, a thin slab of zapoli-wood, and a pile of heniquen-leaves at hand, says Consul Thompson, of Merida, the Yucatecan is ready to accept contracts for hammocks by the piece, dozen, or hundred. The poles are placed a distance apart, according to the required length of the hammock. The thin slab of hard wood is fashioned into a stripper, by the aid of which the fiber of the thick heniquen-leaf is denuded of its envelope, and a wisp of rasped fiber is obtained. This having been bleached, the fibers are separated into a certain number, and these are rolled into a strand. Two or more of these strands are then taken out, and by a similar dexterous manipulation converted into a *han* or cord, from which the hammock is made. The cord is riven rapidly around the two upright poles, and the shuttle, worked by the women, seems to move and seek the right mesh, says Consul Thompson, with a volition of its own—and in a very short space of time the hammock is made and laid with its kind, to await the coming of the contractor. Almost the entire exportation of hammocks from Yucatan is absorbed by the United States. All the districts of the State produce hammocks, but that of Tixcoco more than all the other districts combined. Chemax hammocks are noted for their fineness, and do not have to seek a market abroad.

**What is Fire-proof?**—The idea that theatrical appurtenances of wood and cloth can be made efficiently fire-proof by soaking them with certain chemical solutions is, in the opinion of Mr. Walter Emden, a serious error. Theoretically, the soaking works beautifully, and in practice for a time secures immunity against the spread of fire. "But for how long? Of the majority of these preservative solutions, it is a question if anything is left at the end of a certain time. They evaporate or sublimate or pass off into the atmosphere. No one can say with any degree of certainty for what length of time a beam or a cloth will be fire-proof as the result of soaking in any non-inflammable solution. Now, miscalculations in respect to this may lead to the most terrible catastrophes." A further point of the greatest moment is that gas-flames raise the temperature of wood and canvas in their vicinity to 140° F., and dry them to tinder. Obviously, actual contact with a naked flame must, under such circumstances, produce results altogether different from those of the experiments usually made with preservative solutions. It is the materials themselves which are used in the construction that must be proof against fire. The aim should be, not to make some combustible material incombustible, but to use only fire-proof materials.

**Bread of Water-Lily Seeds.**—The seeds of various species of water-lilies form the food of thousands of people in Asia and some parts of America. The most important species for this purpose are those belonging to the genus *Trapa*, which are known in India as *Singhara*, in China as *Ling*, and generally as water-chestnut. The fruit of the *Trapa bicornis*, which grows in the lakes of

China, is collected by women and children who paddle about among the plants in small circular boats resembling wash-tubs. Other species are grown in Cashmere, where the lakes become so crowded with the plants that navigation is made impossible, and the Government derives £12,000 a year from the taxes on the crop of a single lake; and in India, where the cultivation is systematically carried on. The fruit abounds in starch, which has the flavor of a chestnut, and may be eaten raw or cooked. The dried nuts will keep for many years. The meal may be made into cakes or into a porridge. If the kernels are soaked overnight in cold water, they will be ready in the morning to be boiled or steamed into food. The seeds of the lotus (*Nelumbo*) were much used as food in ancient Egypt, but seem to be neglected now. The tuberous roots resemble the sweet potato and are starchy. The root-stalks when boiled are farinaceous and agreeable, and those of the American species are employed as food by Western Indians. The seeds of the lotus, in India, are eaten raw when green, and roasted or boiled when ripe and hard. The root, which is two or three feet long, is eaten, boiled, as a vegetable. The Klamath Indians live chiefly on the *tookow*, or seeds of the yellow water-lily (*Nuphar lutea*). The capsules are broken, and the seeds are separated from their husks.

**The Philosophy of Waist-Belts and Corsets.**—In the course of an investigation upon the work of the heart in health and disease certain facts were observed by Prof. Roy and Mr. J. G. Adams which throw light upon the physiological bearing of waist-belts, etc. By means of a cardiometer, they register accurately the changes in volume of the heart and the amount of blood propelled by it, under varying conditions. In the dog, even a slight compression of the abdomen caused an increase in volume of the heart, and with this a greatly increased amount of blood, passed through the heart in a given time. These phenomena can be explained without difficulty. The abdominal vessels are capable of containing all, and more than all, the blood in the organism. Slight compression of the abdomen will, without disturbing the arterial supply, drive out from the abdominal veins and venous capillaries a large amount of blood; and this blood will be of use for the other regions of the body. Now, the functional activity of any organ depends directly upon its blood-supply. Increase the arterial blood-supply of any part, and, other things being equal, the activity and power of work of that part are increased. The abdominal walls in front and at the sides are formed of soft, elastic tissues. In health, pressure is, through these, exerted upon the abdominal contents, and at the same time upon the abdominal veins and venous capillaries, by means of the muscles contained in these walls. If, however, the muscles lose their tone, the walls become flaccid, and the veins dilate, and thus holding a larger amount of blood than is necessary, act as reservoirs for this blood, and so deprive the rest of the body of an amount of fluid necessary for its due nutrition. Here, then, we have an explanation of the use of some form or other of waist-belt by all nations who have passed beyond the stage of absolute barbarism. The waist-belt is of use, and has constantly been used, in cases of sudden and great exertion, and in those cases where it becomes necessary to counteract the tendency to a useless storing up of blood in the abdomen; and by persons in health, in bringing more blood into the service of the brain and muscles to produce a condition of increased mental and muscular activity. Flaccid abdominal walls are rather the rule than the exception with women, and among men occur in those leading sedentary lives. We are, therefore, brought to conclude that among women some form of waist-belt is advantageous. Moderate constriction does no harm; extreme constriction is absurd and dangerous.

**The Scilly Islands.**—Scillonians is what the inhabitants of the Scilly Islands call themselves. Though politically attached to Cornwall, and nearer to it than to any other part of the world, they are not Cornish, but of high-blooded English stock, being to a large extent descended from the Godolphins and from royalists who had suffered from the English civil wars. There are, however, considerable local differences between the people of the several smaller islands. In the days of sailing ships the Scilly Islands were an important naval outpost and a place

of refuge for vessels in stormy seasons. The people were skillful ship-builders and prosperous ship-owners. Steam has deprived them of most of their old advantages, and they have had to turn their attention to other pursuits. The mild climate and the good soil of the islands are favorable to all kinds of vegetation. Raising early potatoes and vegetables for the English markets has been a remunerative occupation. Recently the raising of narcissus and other bulbs has promised to be still more profitable, and the people are every year giving more and more attention to it. In 1887 more than a hundred tons of flowers were exported. The small extent of the islands bringing them into close relations, and almost inevitably under one another's eye, the Scillonians are quite sociable and considerably prone to gossip. They give occasional dinners, at which heavy cake and clotted cream are favorite dishes; but they object to dancing and card-playing, and abhor jesting and flippancy. They are great readers, and keep in the current of English periodical literature; and, having had George Eliot and Tennyson to visit them, they are "not to be awed by the prestige of any literary magnate." Finally, Mr. Frank Bonfield says of them, "Most of them seem to have had a tradition of having come in from somewhere at no very remote period of the past, and I am very doubtful if there is any aboriginal population—that is to say, families who have no record or reminiscence handed down of having lived somewhere else."

**Chemical Bibliographies.**—The report of the American Association's Committee on Indexing Chemical Literature mentions as published, the "Provisional List of Abbreviations of Titles of Chemical Journals," Dr. A. Tuckerman's "Index to the Literature of the Spectroscope," and Prof. Clarke's "Table of Specific Gravities"; as completed, Prof. Traphagen's "Index to the Literature of Columbium," and Prof. Bolton's "Bibliography of Chemistry" for 1887; and as in preparation, indexes on "Ethylene," by Mr. A. A. Noyes; "Methane," by Prof. W. P. Mason; "Cæsium and Rubidium," by Mr. William Rupp; "Tantalum," by Prof. Traphagen; a "Bibliography of the History of Chemistry," by Dr. Bolton; and "Thermodynamics," by Dr. A. Tuckerman. Bibliographies are mentioned of "Food Adulteration and its Detection," by Dr. J. P. Battershall; "Milk," by E. W. Martin; and "Butter," adulterations, testing, etc., by Prof. Elwyn Waller and others. Among lists of patents relating more or less to applied chemistry are those of Mr. C. T. Davis on the manufacture of leather; of bricks, tiles, and terra-cotta; of paper; and his "Treatise on Boiler Incrustations"; and Mr. William T. Braunt's "Treatise on Animal and Vegetable Fats and Oils." B. Tollen's "Handbuch der Kohlenhydrate," Breslau, 1888, contains about fifteen hundred references to the literature of carbohydrates. Dr. A. B. Lyons is publishing, in the "Pharmaceutical Era," a monthly "Index Pharmaceuticus." The work of the committee is now being supplemented by chemists in Great Britain.

**Old and New-Fashioned Ideas in Medicine.**—Dr. Malcolm Morris has indicated some points in medical practice in which a mysticism, which was one of its predominant features in the middle ages, still lingers around it. "There remains in the people," he says, "a belief in the efficacy of drugs as drugs—a belief that, as for every bane there must be an antidote, so for every disease there must be a curative leaf or root. Nature is distrusted; disease is still represented as some evil influence to be exorcised. In the popular mind Disease walks the earth as a devouring fiend, and has a personality about it as of old. The phrases 'Stricken with disease,' 'visitations,' and 'seizures,' are survivals of the conceptions of primitive times. . . . The mysticism survives in the courtly phrase and the ambiguous language of the practitioner of modern times. When sorely pressed by the sick man, the physician's only armory is equivocation, from which he draws such verbal weapons as 'the state of the constitution,' 'the tone of the body,' 'the general health,' 'lowered vitality,' and all that kind. . . . Are these not in some sort a survival of the circle of the horoscope?" The profession is also at a disadvantage because of a skepticism, reacting from the implicit faith in drugs of the olden time, which "repudiates all aids and accessories; briefly, it states its deliberate opinion that disease is infinitely better left to itself. The natural

physiological energy of the body is the prime element in the healing process. This is neither more nor less than modern fatalism —waiting on events. Such a doctrine, if successful, would be fatal to medicine." A third evil under which it suffers is materialism, which "in medicine may be carried to an injurious extreme. In modern pathology, for example, as originated by the German school and taught by its apostles, while men are actively contesting as to the nature or formation of a certain cell—whether it be spindle-shaped, round, or ovoid; whether it be derived from this tissue or from that—they are likely to lose sight of the real bearings of the case. By all means respect facts, and you can not show better respect for them than by using them. A medical inquirer is not a mere collector. Collect your facts, and then reason from the data you have established. A collection teaches nothing till it has been arranged. The tendency at present is, in the majority of instances, to collect everything, and to arrange and therefore to adduce nothing."

**Sanitary Science and Children's Health.** —Among the greatest gains that have recently been made in sanitary science, Mr. Edwin Chadwick counts the power that has been obtained of preventing children's diseases. "In the larger district schools," he says, "the districts of the poor-law unions, the children's chief diseases are now practically abolished. These institutions may be said to be children's hospitals, in which children, orphans of the lowest type from the slums, are taken in large proportions with developed diseases upon them, often only to die from constitutional failure alone. Yet in a number of these separate schools there are now no deaths from measles, whooping-cough, typhus, scarlatina, or diphtheria. The general death-rate is about ten in one thousand, and of those who are not in the probationary wards, of those who come in without developed disease upon them, the death-rates are now less than three in one thousand, or less than one third of the death-rates prevalent among the children of the general population of the same ages." In an institution where the old death-rate was twelve in one thousand, by drainage and clearance of sewage-smells the rate was reduced by more than one third; then, after improving the ventilation of the rooms and providing a separate bed for each child, the rate was reduced to less than three in one thousand, "and that with children of the lowest type. In a visit to one of these half-time schools, after an interval of several years, I was so struck with the appearance of the children as less pallid and with less of the dull, leathery look that I had seen before—they were bright and fresh-looking —that I observed to the manager that he must have had a new class of children since my last visit. His answer was 'No,' but that since the sanitary improvements had been made in the lower districts the children received from them were of the improved type which had struck me."

**American India-Rubber.** — The India-rubber of Central America is obtained from varieties of *Castilloa*, which yield rubber very little inferior to that obtained from the *Siphonia*. To raise India-rubber plants which are indigenous to one place in another where the conditions are at all favorable is no difficult task, but to make the same plant successfully productive is another matter altogether. Mr. Thomas B. Warren has called attention to the influence which handling raw rubber with sweaty or dirty hands has in promoting its decay. The less the raw article is fashioned by the hands in handling, the better. Grease of any kind, even in small quantity, is pernicious to the durability of the substance. When handled too much in manufacturing, it is sure to show signs of decay after a short time in the parts most exposed to manipulation. It makes a great difference in the quality of the raw product whether it has been collected by a relatively clean Brazilian creole or by a fatty-perspiring African. When rubber shows signs of decay from this cause, dusting over with raw sulphur tends to arrest it.

**Whisky no Antidote for Rattlesnake-Poison.**—The popular opinion that whisky is an antidote to rattlesnake-bite is controverted by Dr. A. T. Hudson, of Stockton, Cal., on the authority of experiments by Dr. S. Weir Mitchell. Dr. Mitchell mixed the virus of the rattlesnake with alcohol and with other reputed antidotes, and found,

on injecting the solution into animals, that its power was not altered. He found also that the effect of the virus was subject to very well defined limits, and that a quantity which would kill an animal of a certain size was much less powerful, or inert, upon larger animals. If a large snake should bite a goat of about fifty pounds' weight, and afterward two children of corresponding weight, he might kill the goat, while the children would survive, because not enough virus was left after the goat was bitten seriously to harm the children; then, if whisky were given to the children, their recovery would be attributed to it, while it really had nothing to do with the matter. It is rare that an adult person dies from the bite of a rattlesnake. Whisky may, however, be regarded as physiologically antidotal, in so far as it will sustain the flagging powers while the poison is being eliminated by the excretory organs.

**The Teak-Tree.**—Teak-wood is the most important of the forest products of Siam. It is used in immense quantities throughout the East for house-building, and is largely exported to China and Europe for ship-building purposes. It is said to be unsurpassed for resisting the ravages of the white ants and the effects of the weather. It grows in the northern part of Siam and Burmah at a height of 1,200 feet and more above the sea, and reaches its greatest perfection in about a hundred and twenty years; but a good-sized tree that can be cut down when quality of wood is not an object, can be grown in ten or fifteen years. The teak district is from 100 to 150 miles wide. The forests are in charge of the governors of the provinces in which they are situated. They are generally leased for a term of ten years, and the lessee is obliged to fell and remove the greatest number of logs possible, paying a definite royalty to the governor. The trees are girdled, and are left standing for two years to allow the sap to run out and the wood to become perfectly dry. The cutting down takes place in the dry season, and the logs are left until sufficient rain has fallen to allow of their being dragged to the river with the help of elephants. After the logs are made up into rafts, they are delivered to the raftsmen to convey to Bangkok; when all is ready, the evil spirits of the river must be propitiated, the cost of which is paid by the owner of the timber. This custom remains in force, despite the efforts of the foreign and educated classes to stop it, and should any one ignore it he would be unable to procure raftsmen.

**Discovery by Observation.**—The circumstances attending an archæological discovery recently made in German Altenburg, on the Danube, illustrate in the most striking manner the value of intelligent observation. Prof. Hauser was interested for a month in watching the colors of an extensive cornfield, which varied in every part. He found an elevated post of observation, and, after a week's close attention, declared it to be his opinion that the corn was growing over the site of an ancient amphitheatre. His drawings showed that the oblong centerpiece was somewhat concave, and the corn was quite ripe in that part, because there was much soil between the surface and the bottom of the theatre. Elliptical lines of green, growing paler the higher they rose, showed the seats, and lines forming a radius from the center showed the walls supporting the elliptical rows of seats. Excavations were made as soon as the corn had been harvested, which confirmed the professor's theory in nearly every particular. At six inches below the soil the top of the outer wall was found, and from there the soil gradually grew thicker until the bottom of the arena was reached, the pavement of which is in perfect condition. From the theatre a paved road leads to the Camp of Carnuntum.

**The Buddhist Story of the Partridge.**—Among the Buddhist stories which Mr. T. W. Rhys Davids has made known to the public is a legend of 400 B. C., pertinent to the question of the standards of precedence. It runs to the effect that a partridge, a monkey, and an elephant, friends, dwelling near a great banyan-tree, discussing which should be considered first, inquired which was the oldest among them. The elephant, when asked how far back he could remember, replied that when he was a little elephant he used to walk over the banyan-tree, and its topmost twig just grazed his belly. The monkey, when quite a little monkey, could gnaw

the topmost twig of the tree as he squatted on the ground. But the partridge said: "Friends, there used to be another banyan-tree. One day, after eating of its fruit, I voided a seed here. Hence this tree." So they agreed, the story continued, to honor and reverence the partridge, as he was the oldest, and he trained the others in obedience to the Five Precepts. Thenceforward they lived together in so beautiful a harmony that it became a proverb, and was known as "the beautiful life of the partridge." And they all three went, after death, to heaven. The story accords with the general idea among the ancients that the birds were of very old lineage.

**Asphalt and Petroleum in Venezuela.**—A part of the department of Colon, in Venezuela, is very rich in asphalt and petroleum. At one place a thick bitumen is ejected from the mouth of a cave, in globules which explode with considerable noise. The place called the *infernito*, or little hell, is a mound of sand, from twenty-five to thirty feet high, on the surface of which are numerous holes of different sizes, whence petroleum and hot water are ejected with a noise equal to that caused by two or three steamers blowing off at once. Considering the immense amount of inflammable gases that accompany such flows of petroleum, it is suggested that something of the kind may be connected with the *Taro* of Maracaybo—a constant lightning without thunder, which is observed from the foot of the bar at the entrance to the lake. Croppings of asphalt and coal appear at the foot of the mountains in the department of Sucre; and near the mountains is a flow of a black liquid, distinct from asphalt or petroleum, and apparently identical with a substance which occurs among anthracite deposits.

**Habits of Turtles.**—Turtles are described as sleepy creatures that rest at intervals throughout the day and become abnormally active at night. When asleep they lie upon the bottom of their habitat, with their heads downward and eyes closed, and are not easily disturbed. Their weight is considerable, and precludes them from moving constantly in the water; and, as a rule, when swimming they keep near the surface, and stretch their heads out, in order to gulp in air readily. Upon land they are helpless, almost as powerless as the seal in a similar situation. They capture their prey with great agility, for, with their long necks, they can thrust their heads forward very rapidly. The head, fin, and tail are independent of the shell, and move freely, but can not be drawn wholly under the shell, like those of the tortoise. Turtles, especially young ones, are very pugnacious, and fight by striking their adversary's head with their fins and biting. Mr. Carter, of the British National Fish-Culture Association, thinks it practicable to propagate them artificially. The eggs should be placed in sand, heated from beneath by water-pipes to a constant temperature of 70° F., which could be raised in the daytime to 100° by concentrating the temperature from without. The young turtles will seek for water at once, and this should be provided, warmed to 100°. While propagation in this way might be profitable, it would not be easy to domesticate the animals to our cool latitudes.

**Influence of Antiseptics on Foods.**—It has become common in trade to apply antiseptics to perishable foods, in order to preserve them, salicylic acid being probably the most used. It is important to ascertain what the effect of the addition is upon the quality of the food, and upon the digestive functions. Lehmann has shown that salicylic acid does not usually contribute any injurious quality to food, but apprehends that the indiscriminate use of such substances may be dangerous. Experiments have been made in our Department of Agriculture to determine what effect in retarding digestion may be possessed by such substances as salicylic acid, boric acid, sodium acid sulphite, saccharine, beta-naphthol, and alcohol. It was found that salicylic acid prevents the conversion of starch into sugar under the influence of either diastase or pancreatic extract, but does not very seriously interfere with peptic or pancreatic digestion of albumen. Saccharine holds about the same relation as salicylic acid. Sodium acid sulphite and boric acid are practically without retarding effect. Beta-naphthaline interferes decidedly with the formation of sugar by diastase, but not with the action of pancreatic extract

on starch. Peptic and pancreatic digestion of albuminoids were almost prevented by it. The experiments show that the indiscriminate use of these agents, without sanitary inspection, should not be allowed.

**Bells as Weather Indicators.**—M. P. J. de Ridder, of Lebbeke, Belgium, has observed that bells are heard further away when the atmosphere is in cyclonic motion, and that a calm atmosphere, saturated with moisture, favors the transmission of sound, while contrary winds are not always an obstacle. Certain small bells six and eight kilometres southeast from Lebbeke are called water bells by the people there, because their being heard at Lebbeke is immediately followed by a season of rain. And, generally, the hearing of a distant sound, like that of a bell or the rumbling of a railway train, is regarded as portending the end of fine weather and the approach of rain. One bell, which is ten kilometres away, is heard twice a year—in March or April, and in September or October—and always in identical conditions of the sky.

## NOTES.

We are indebted to the kindness of the Tiffany Glass Company, of New York, for the use of the photographs from which the illustrations were engraved for Prof. Henderson's article on "The History of a Picture-Window," in this issue of the "Monthly."

Alaska is commonly thought of as an exceedingly cold place, but, except in the northern part, this reputation is not justified. To be sure, in the Yukon district, comprising the country north of the Alaskan Mountains, the mean annual temperature is about 25° Fahr., and the ground thaws in summer only two or three feet down from the surface, remaining frozen continually below. In the Aleutian Peninsula and Islands, however, the mean is from 36° to 40°, and in a series of observations, extending over five years, the greatest cold was found to be zero, while the highest temperature was 77°. A still warmer and a moist climate belongs to the Sitka district, the strip extending down along the coast of British America. Here the mean is 44·7°, and the temperature during the winter seldom goes so low as the freezing-point. The mean annual temperature of the State of New York is 46·49°.

The French Academy of Sciences has awarded its Cuvier medal to Prof. Joseph Leidy, of Philadelphia, for his eminent services in zoölogy. The medal was accompanied by a letter recognizing Dr. Leidy as a leader in his specialty.

The report of the United States Commissioner of Education shows the following percentages of increase in ten years (1876–'77 to 1886–'87), in the five divisions of the Union, in population, school enrollment, and school expenditure:

| DIVISIONS. | Population. | Enrollment. | Expenditure. |
|---|---|---|---|
| North Atlantic division | 16·5 | 5·7 | 21·7 |
| South Atlantic division | 26·7 | 58·7 | 50·4 |
| South Central division | 36·8 | 83·4 | 65·4 |
| North Central division | 32·0 | 29·7 | 51·1 |
| Western division | 72·1 | 58·3 | 75·9 |
| United States | 29·0 | 31·1 | 41·1 |

Some erroneous opinions respecting reptiles are corrected by Arthur Ayling in "Science Gossip." Thus, the slow-worm or blind-worm (*Anguis fragilis*) is not blind, but has eyes which, though small in comparison with its size, are very bright, and are in fact the prettiest part of its body; and it can not inflict a poisonous bite. Snakes do not "sting" with their forked tongues. Reptiles can live a long time without food—a triton, for instance, has been kept in that condition for six months—but they die in the end; and stories of toads having been imprisoned in rocks for years or ages under circumstances where air was excluded from them are false. Toads can not "spit fire," and newts and lizards can not inflict dangerous bites.

Dr. F. B. Jessett, of London, claims to have shown, from a comparison of the number of deaths in England and Wales in various years, that the mortality from cancer increased from 4,966 in 1850 to 13,542 in 1881, and the death-rate per million inhabitants from 320 to 520. In view of these facts, he suggests that, instead of shirking the subject, it should be met, the cause of the mortality studied, and a remedy sought.

Nervelessness is mentioned by the "North China Herald" as the distinguishing quality of the yellow race. A Chinaman can go through the most tedious and monotonous work from hour to hour and from day to day, without any appreciable sense of weariness or irritation; and a school-boy can do the same with his lessons without even longing to be at play. The Chinese can also sleep under conditions which would make a European very uncomfortable and restless. This quality is one of the things that make the Chinese such unwelcome competitors in the labor markets.

The hamlet of Nivezé, near Spa, in Belgium, is infested with what the inhabitants call "bad-air wells," or outlets whence carbonic-acid gas exhales. Dr. Parkin, of Spa, describes eight spots whence the exhalations are abundant, and most so in times of storm

and seasons of low barometer. In some the escaping gas makes noises that can be heard from sixty feet away. The ground presents no peculiar appearance, except that nothing will grow immediately around the outlets. Some of these places are under houses, or near them, and cause considerable inconvenience. Dr. Parkin believes that the phenomena are connected with the volcanic region of the Eifel. Prof. Lancaster, of Brussels, thinks that the source of the gas is deeply seated in the earth.

An experiment has been tried at Guildford, England, to test Mr. Conder's system for treating and purifying sewage with a list of ingredients, a principal one of which is sulphate of iron. An open wire-work cage containing the purifying material was let down into the sewer and immersed for about an inch and a half in depth into the flowing sediment. The result is reported to have been a vast improvement in the character of the liquid flowing from the drains into the river, and an abatement of nuisance at points where heretofore nuisances and offensive smells had been complained of.

"Omitting articles in which its occurrence has been purely accidental," says Mr. A. W. Stokes, in "The Chemical News," "arsenic has been found of late years to be present in some samples of muslins, cretonnes, wall-papers, playing-cards, the glaze of some enameled stew-pans, the paper of fancy boxes, and in some furs. These last are usually the furs prepared by amateurs. . . . One has no wish to be an alarmist, or in any way to harass trade, and it must freely be acknowledged that cases of any ill results whatever being traced to the use of these articles are very rare. None the less, seeing how unnecessary they are, and how each year arsenic seems to be finding its way into new quarters, it seems advisable to stop its further progress."

To furnish the French railroads with cross-ties — 10,000 a day and 3,650,000 a year—more than a thousand fine trees have to be cut down every day. In the United States more than 15,000,000 cross-ties are used yearly, to furnish which requires the destruction of 197,600 acres of forests. The "Bulletin du Musée Commercial" estimates the number of logs required for the railways of the world at more than 40,000,000.

## OBITUARY NOTES.

The Rev. John George Wood, one of the most popular and instructive of natural history writers, died March 3d, while on a visit to Coventry, England. He was born in London, the son of a surgeon, in 1827, and was graduated from Merton College, Oxford, in 1848. He served for two years in the Anatomical Museum at Christ Church, Oxford; held two chaplaincies, and was Precentor of the Canterbury Diocesan Choral Union. His best efforts were given to his books, most of which were on natural history. The chief of them was his large "Natural History," in three volumes; the best known, the "Common Objects of the Seashore." Among the others, besides those of the "Common Objects" series, were his "Popular Natural History," "Sketches and Anecdotes of Animal Life," "The Boys' Own Natural History Book," "My Feathered Friends," "Homes without Hands," "Insects at Home," "Our Garden Friends and Foes," several educational works, and a series of "Natural History Readers" for schools. He edited for some time "The Boys' Own Magazine," and was a popular lecturer.

Sir William O'Shaughnessy Brooke, F. R. S., who was distinguished by his connection with electric telegraphs, died in England in January. He was Director-General of Telegraphs in India for ten years, and received a knighthood for his services in establishing telegraphs in that empire.

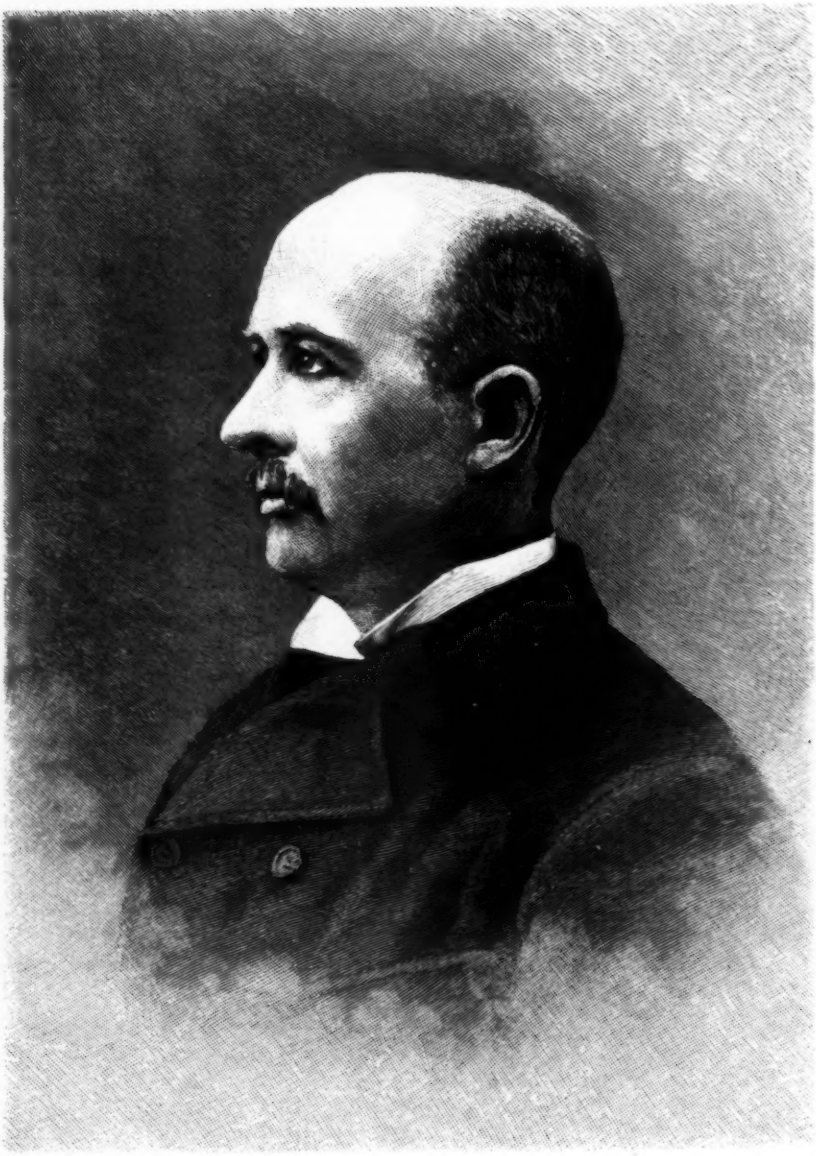
Alexander Pagenstecher, Director of the Museum of Natural History at Hamburg, died January 5th, of heart-disease, in his sixty-fourth year. He was for many years Professor of Zoölogy at Heidelberg, and was the author of a well-known work on "Universal Zoölogy" ("Allgemeine Zoologie") in four volumes (1875–1881).

Dr. Johannes Brock, appointed Professor of Natural Science at Göttingen, has recently died there. He was formerly Professor of Zoölogy at Dorpat, and was well known by reason of a scientific journey to the Indian Archipelago which he undertook under the auspices of the Berlin Academy.

Dr. J. Soyka, Professor of the German University of Prague, and formerly of the University of Munich, and author of books on bacteria, died by suicide, February 23d.

Captain John Ericsson, the inventor of the caloric engine, the Monitor, and other useful or warlike agents, died in this city, March 8th, in the eighty-sixth year of his age. He was a native of Sweden and came of a family of engineers. He showed his inventive capacity at an early age. He came to this country in 1839, and two years afterward began the Princeton, the first naval vessel to carry her machinery under the water-line and out of the reach of the enemy's shot. His name is also identified with the invention of the submarine boat Destroyer, sun motor, and submarine motor; and some of his unpatented inventions are in the hands of the Delamater Iron Company.

The Rev. Dr. Churchill Babington, an English botanist, died January 12th, at Cockfield Rectory. He was a contributor to Sir J. Hooker's "Journal of Botany and Kew Miscellany."



WILLIAM GRAHAM SUMNER.